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ABSTRACT

This document is designed to help teachers identify those math skills that students must master to complete the vocational competencies taught in industrial education classes. Included in the document are 10 program area/math skills matrices that were developed as a result of a research development project during which secondary-level Missouri industrial education teachers listed the math core competencies and key skills required for and/or currently taught in the state's industrial education programs. Matrices are provided for the following program areas: air conditioning, heating, and refrigeration; auto collision technology; automotive technology; building trades; drafting; electronics; graphic arts (offset lithography); health services assistant; machine technology; and welding. Each three-column matrix identifies the vocational competencies involved in the given program area, the math skills involved in the said vocational competencies, and an indication of whether the math skills will be new to students in the vocational classroom or whether they have already been covered by math courses in grades 2-10. An appendix based on the math skills identified in the 1990 "Core Competencies and Key Skills for Missouri Schools" contains additional information about the math skills listed in the second column of each matrix. (MN)

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Integrating

VOCATIONAL COMPETENCIES AND MATH SKILLS INDUSTRIAL EDUCATION

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AIR CONDITIONING

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Appreciation is given to the vocational teachers who took time to identify the vocational competencies in their areas that involve math skills, and to the math teachers who worked with the vocational teachers to identify the specific math skills involved, using the 1990 Core Competencies and Key Skills for Missouri Schools as a guide.

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FOREWORD

National interest and legislation support the need for identifying core competencies and key skills taught in industrial education classes. An understanding of the basic competencies involved will help identify academic subjects as they relate to specific occupations.

The following program area/math skills matrix can therefore be a valuable resource for program integration of academics, pre-testing and skills assessment, and special needs curriculum development. It identifies the math core competencies and key skills required for/taught in one of ten program areas at the Missouri secondary level. Matrices were developed for: Air Conditioning, Heating, and Refrigeration; Auto Collision Technology; Automotive Technology; Building Trades; Drafting; Electronics; Graphic Arts (Offset Lithography); Health Services Assistant; Machine Technology; and Welding.

The materials used to create the matrix include: the 1990 Core Competencies and Key Skills for Missouri Schools, grades two through ten; and Instructional Materials Laboratory vocational program competency profiles for the program areas involved.

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TO THE INSTRUCTOR: SUGGESTIONS FOR USE

The matrix that follows is divided into three columns. Reading in a row across all three of the columns will identify which math skills are involved in each vocational competency and tell whether the math skills are new to students or simply need reinforcement.

The first column identifies the vocational competencies involved in the program area. The numbers and competencies in this column refer to the Instructional Materials Laboratory competency profile for the program area.

The second column identifies which math skills are involved in the vocational competencies. The skills and numbers listed in this column refer to the 1990 Core Competencies and Key Skills for Missouri Schools, grades two through ten. (The list can also stand alone as a general list of math skills.) The column is blank for any vocational competency that the committee members decided did not require math skills.

Additional information about the math skills listed in the second column of the matrix may be found in the appendix following the matrix. The appendix is based on the math skills identified in the 1990 Core Competencies and Key Skills for Missouri Schools.

The last column tells whether the math skills will be new to students in the vocational classroom or whether they have been covered by math courses in the second through tenth grades. You may want to review and/or reinforce the math skills that students already have, and to make arrangements for them to learn the skills that are new to them.

As you use the matrix to help students learn or review math skills, keep in mind that different students learn in different ways. Efforts should be made to ensure that all students have an equal opportunity to understand and learn the material, regardless of race, color, national origin, gender, age, or disability.

Hold high expectations for all students, and provide the instruction necessary for students to meet those expectations. It is important that students achieve in math because research has shown a link between attitude toward mathematics and science, self-esteem levels, and career aspirations. According to a survey by the American Association of University Women: "Girls and boys who like mathematics and science have higher self-esteem, more ambitious career goals, and are more likely to hold onto their dreams."

As you help students achieve and develop this positive attitude toward mathematics, be aware that students of different genders give different reasons for their lack of interest in math. The AAUW survey states: "The gender differences in the intertwining of self-esteem and math/science interest is most evident in girls' and boys' reasons for their declining interest in math and science. While boys 'externalize' by seeing math and science as unimportant, girls 'internalize' by thinking themselves not smart enough."

AIR CONDITIONING, HEATING, AND REFRIGERATION		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
A1. Identify types, purposes and operation of fire extinguishers		
A2. Inspect shop for hazards		
A3. Work cautiously and safely	Problem Solving Follow a series of instructions in sequential order (8G-4)	R
A4. Demonstrate removal procedures from an electrical conductor	Problem Solving Follow a series of instructions in sequential order (8G-4)	R
A5. Demonstrate knowledge of safe refrigerant handling	Graphing and Statistics Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving Follow a series of instructions in sequential order (8G-4)	R
B1. Identify principles of refrigeration		
B2. Use high and low manifold gauge	Computation Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Measurement Estimate measurement (7D-2)	R
	Solve problems involving measurement (10D-11)	R
	Graphing and Statistics Construct, read, and interpret displays of data (7F-2)	R

AIR CONDITIONING, HEATING, AND REFRIGERATION		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
C2. Demonstrate safety procedures and precautions	Problem Solving Follow a series of instructions in sequential order (8G-4)	R
C3. Install, repair and replace copper tubing	Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Estimate measurement (7D-2) - Solve problems involving measurement (10D-11)	R R R
C4. Install, repair and replace aluminum tubing	Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Estimate measurement (7D-2) - Solve problems involving measurement (10D-11)	R R R
C5. Install and replace plastic tubing and pipe	Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Estimate measurement (7D-2) - Solve problems involving measurement (10D-11)	R R R
C6. Braze tubing	Problem Solving Follow a series of instructions in sequential order (8G-4)	R

AIR CONDITIONING, HEATING, AND REFRIGERATION		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
C7. Identify and use related tools and instruments	Problem Solving Follow a series of instructions in sequential order (8G-4)	R
C8. Use tools and instruments safely	Graphing and Statistics - Construct, read, and interpret displays of data (7F-2) Problem Solving - Follow a series of instructions in sequential order (8G-4)	R R
D1. Demonstrate safety procedures and precautions	Problem Solving Follow a series of instructions in sequential order (8G-4)	R
D2. Describe the major concepts of electrical theory	Computation - Compute the sum, difference, product, or quotient of fractions (7B-8) - Solve formulas for a given variable (10B-10)	R R

AIR CONDITIONING, HEATING, AND REFRIGERATION		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
D3. Identify and use test equipment	Understanding Numbers • Apply number theory (8A-7)	R
	Computation • Recall fraction\decimal\percent equivalents (7B-1)	R
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	• Solve formulas for a given variable (10B-10)	R
	Measurement • Convert units of measure within a system (6D-9)	R
D4. Interpret electrical diagrams	Graphing and Statistics • Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving • Follow a series of instructions in sequential order (8G-4)	R
D5. Troubleshoot complete electrical circuit	Problem Solving • Follow a series of instructions in sequential order (8G-4)	R

AIR CONDITIONING, HEATING, AND REFRIGERATION		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
D6. Test capacitors	Understanding Numbers Use mathematical relationships to simplify expressions (10A-5)	R
	Estimation Estimate solutions for various computational problems (10C-1)	R
	Problem Solving Follow a series of instructions in sequential order (8G-4)	R
D7. Install circuit wiring to local code	Problem Solving Follow a series of instructions in sequential order (8G-4)	R
D8. Describe the major concepts of electric motor theory		
D9. Test electrical components	Estimation Estimate solutions for various computational problems (10C-1)	R
	Solve problems utilizing estimation (10C-5)	R

AIR CONDITIONING, HEATING, AND REFRIGERATION		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
E1. Demonstrate safety procedures and precautions	Understanding Numbers Compare rational numbers (8A-2)	R
	Computation Recall fractions\decimal\ percent equivalents (7B-1)	R
	Measurement Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Graphing and Statistics Construct, read, and interpret displays of data (7F-2)	R
E2. Describe concept of control theory and application		
E3. Install, replace and adjust electrical controls	Measurement Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Solve problems involving measurement (10D-11)	R
	Graphing and Statistics Construct, read, and interpret displays of data (7F-2)	R

AIR CONDITIONING, HEATING, AND REFRIGERATION		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
E4. Install and replace temperature pressure control	Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Solve problems involving measurement (10D-11) Graphing and Statistics - Construct, read, and interpret displays of data (7F-2)	R R R
E5. Adjust temperature pressure control	Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Solve problems involving measurement (10D-11) Graphing and Statistics - Construct, read, and interpret displays of data (7F-2)	R R R
E6. Install and replace solid-state control	Graphing and Statistics - Construct, read, and interpret displays of data (7F-2) Problem Solving - Follow a series of instructions in sequential order (8G-4)	R R

AIR CONDITIONING, HEATING, AND REFRIGERATION		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
E7. Replace, calibrate and adjust temperature control	Understanding Numbers Use mathematical relationships to simplify expressions (10A-5)	R
	Graphing and Statistics Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving Follow a series of instructions in sequential order (8G-4)	R
E8. Install, repair, replace and adjust time control	Understanding Numbers Use mathematical relationships to simplify expressions (10A-5)	R
	Measurement Tell and record time (3D-3)	R
	- Convert units of measure within a system (6D-9) - Solve problems involving measurement (7D-11)	R
	Graphing and Statistics Construct, read, and interpret displays of data (7F-2)	R
E9. Install and replace water regulating valve	Measurement Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Solve problems involving measurement (10D-11)	R
	Graphing and Statistics Construct, read, and interpret displays of data (7F-2)	R

AIR CONDITIONING, HEATING, AND REFRIGERATION		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
E10. Adjust water regulating valve	Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Solve problems involving measurement (10D-11) Graphing and Statistics - Construct, read, and interpret displays of data (7F-2)	R R R
E11. Install and replace oil pressure safety control	Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Solve problems involving measurement (10D-11) Graphing and Statistics - Construct, read, and interpret displays of data (7F-2)	R R R
E12. Install and replace pneumatic controls	Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Solve problems involving measurement (10D-11) Graphing and Statistics - Construct, read, and interpret displays of data (7F-2)	R R R
E13. Install, replace and repair magnetic starter components	Problem Solving Follow a series of instructions in sequential order (8G-4)	R

AIR CONDITIONING, HEATING, AND REFRIGERATION		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
E14. Install and replace current relay	Problem Solving Follow a series of instructions in sequential order (8G-4)	R
E15. Install and replace potential relay	Problem Solving Follow a series of instructions in sequential order (8G-4)	R
E16. Install and replace control relay	Problem Solving Follow a series of instructions in sequential order (8G-4)	R
E17. Install and replace transformer	Problem Solving Follow a series of instructions in sequential order (8G-4)	R
E18. Describe concept of programmable thermostats		
E19. Identify the components of a 4-way reversing valve		
F1. Demonstrate safety procedures and precautions	Problem Solving Follow a series of instructions in sequential order (8G-4)	R
F2. Test compressor efficiency	Measurement Solve problems involving measurement (10D-11)	R
	Graphing and Statistics Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving Follow a series of instructions in sequential order (8G-4)	R

AIR CONDITIONING, HEATING, AND REFRIGERATION		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
F3. Install and replace compressor	Understanding Numbers - Use mathematical relationships to simplify expressions (10A-5) Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Solve problems involving measurement (10D-11) Graphing and Statistics - Construct, read, and interpret displays of data (7F-2)	R R R R
F4. Install and replace access valve	Graphing and Statistics - Construct, read, and interpret displays of data (7F-2) Problem Solving - Follow a series of instructions in sequential order (8G-4)	R R
F5. Repair and replace condenser	Understanding Numbers - Use mathematical relationships to simplify expressions (10A-5) Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Solve problems involving measurement (10D-11) Graphing and Statistics - Construct, read, and interpret displays of data (7F-2)	R R R R

AIR CONDITIONING, HEATING, AND REFRIGERATION		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
F6. Repair and replace evaporator	Understanding Numbers Use mathematical relationships to simplify expressions (10A-5)	R
	Measurement Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Solve problems involving measurement (10D-11)	R
	Graphing and Statistics Construct, read, and interpret displays of data (7F-2)	R
F7. Repair and replace metering devices	Understanding Numbers Use mathematical relationships to simplify expressions (10A-5)	R
	Measurement Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Solve problems involving measurement (10D-11)	R
	Graphing and Statistics Construct, read, and interpret displays of data (7F-2)	R
F8. Replace components of defrost system	Graphing and Statistics Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving Follow a series of instructions in sequential order (8G-4)	R

AIR CONDITIONING, HEATING, AND REFRIGERATION		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
F9. Replace temperature controls	Graphing and Statistics Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving Follow a series of instructions in sequential order (8G-4)	R
F10. Replace motor control devices	Graphing and Statistics Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving Follow a series of instructions in sequential order (8G-4)	R
F11. Replace heaters	Graphing and Statistics Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving Follow a series of instructions in sequential order (8G-4)	R
F12. Perform cleanup of a contaminated system	Understanding Numbers Use mathematical relationships to simplify expressions (10A-5)	R
	Measurement Solve problems involving measurement (10D-11)	R
	Graphing and Statistics Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving Follow a series of instructions in sequential order (8G-4)	R

AIR CONDITIONING, HEATING, AND REFRIGERATION		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
F13. Charge refrigeration system	Understanding Numbers • Use mathematical relationships to simplify expressions (10A-5) Measurement • Solve problems involving measurement (7D-11) Graphing and Statistics • Construct, read, and interpret displays of data (7F-2)	R R R
F14. Perform preventative maintenance	Measurement • Solve problems involving measurement (10D-11) Graphing and Statistics • Construct, read, and interpret displays of data (7F-2) Problem Solving • Follow a series of instructions in sequential order (8G-4)	R R R
F15. Interpret wiring diagram - refrigerator	Problem Solving • Follow a series of instructions in sequential order (8G-4)	R
F16. Check and adjust air flow	Measurement • Choose the appropriate unit of precision for a given measurement situation (7D-1) • Solve problems involving measurement (7D-11) Graphing and Statistics • Construct, read, and interpret displays of data (7F-2)	R R R

AIR CONDITIONING, HEATING, AND REFRIGERATION		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
F17. Identify and use related tools and instruments	Measurement - Solve problems involving measurement (10D-11) Graphing and Statistics - Construct, read, and interpret displays of data (7F-2) Problem Solving - Follow a series of instructions in sequential order (8G-4)	R R R
G1. Test compressor efficiency	Measurement - Solve problems involving measurement (10D-11) Graphing and Statistics - Construct, read, and interpret displays of data (7F-2) Problem Solving - Follow a series of instructions in sequential order (8G-4)	R R R
G2. Install, replace and repair compressor	Measurement - Solve problems involving measurement (10D-11) Graphing and Statistics - Construct, read, and interpret displays of data (7F-2) Problem Solving - Follow a series of instructions in sequential order (8G-4)	R R R

AIR CONDITIONING, HEATING, AND REFRIGERATION		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
G3. Install and replace condensing unit	Measurement	R
	- Solve problems involving measurement (10D-11) Graphing and Statistics - Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving Follow a series of instructions in sequential order (8G-4)	R
G4. Install, repair and replace stem-type valve	Measurement	R
	- Solve problems involving measurement (10D-11) Graphing and Statistics - Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving Follow a series of instructions in sequential order (8G-4)	R
G5. Install, replace and test control valves	Measurement	R
	- Solve problems involving measurement (10D-11) Graphing and Statistics - Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving Follow a series of instructions in sequential order (8G-4)	R

AIR CONDITIONING, HEATING, AND REFRIGERATION		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
G6. Repair and replace condenser	Measurement - Solve problems involving measurement (10D-11) Graphing and Statistics - Construct, read, and interpret displays of data (7F-2) Problem Solving - Follow a series of instructions in sequential order (8G-4)	R R R
G7. Repair and replace evaporator	Measurement - Solve problems involving measurement (10D-11) Graphing and Statistics - Construct, read, and interpret displays of data (7F-2) Problem Solving - Follow a series of instructions in sequential order (8G-4)	R R R
G8. Replace and repair metering device	Measurement - Solve problems involving measurement (10D-11) Graphing and Statistics - Construct, read, and interpret displays of data (7F-2) Problem Solving - Follow a series of instructions in sequential order (8G-4)	R R R

AIR CONDITIONING, HEATING, AND REFRIGERATION		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
G9. Adjust metering device	Computation • Compute the sum, difference, product, or quotient of integers (8B-6)	R
	Measurement • Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (10D-11)	R
	Problem Solving • Follow a series of instructions in sequential order (8G-4)	R
G10. Replace defrost system components	Understanding Numbers • Use mathematical relationships to simplify expressions (10A-5)	R
	Measurement • Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Investigate the relationships among circumference, area, and diameter of a circle (7D-10)	R
	Problem Solving • Follow a series of instructions in sequential order (8G-4)	R
G11. Replace heaters	Problem Solving • Follow a series of instructions in sequential order (8G-4)	R

AIR CONDITIONING, HEATING, AND REFRIGERATION		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
G12. Perform cleanup of a contaminated system	Understanding Numbers Use mathematical relationships to simplify expressions (10A-5)	R
	Measurement Solve problems involving measurement (10D-11)	R
	Graphing and Statistics Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving Follow a series of instructions in sequential order (8G-4)	R
G13. Charge refrigeration system	Understanding Numbers Use mathematical relationships to simplify expressions (10A-5)	R
	Measurement Solve problems involving measurement (10D-11)	R
	Graphing and Statistics Construct, read, and interpret displays of data (7F-2)	R
G14. Check and adjust air flow	Measurement Solve problems involving measurement (10D-11)	R
	Graphing and Statistics Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving Follow a series of instructions in sequential order (8G-4)	R

AIR CONDITIONING, HEATING, AND REFRIGERATION		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
G15. Identify and use related tools and instruments	Measurement Solve problems involving measurement (10D-11)	R
	Graphing and Statistics Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving Follow a series of instructions in sequential order (8G-4)	R
G16. Pump down unit	Computation Compute the sum, difference, product, or quotient of integers (8B-6)	R
	Measurement Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Problem Solving Follow a series of instructions in sequential order (8G-4)	R
G17. Perform preventative maintenance	Measurement Solve problems involving measurement (10D-11)	R
	Graphing and Statistics Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving Follow a series of instructions in sequential order (8G-4)	R

AIR CONDITIONING, HEATING, AND REFRIGERATION		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
G18. Interpret wiring diagram	Problem Solving Follow a series of instructions in sequential order (8G-4)	R
H1. Demonstrate safety procedures and precautions	Computation Compute the sum, difference, product, or quotient of intergers (8B-6)	R
	Measurement Solve problems involving measurement (10D-11)	R
	Graphing and Statistics Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving Follow a series of instructions in sequential order (8G-4)	R
H2. Test compressor efficiency	Measurement Solve problems involving measurement (10D-11)	R
	Graphing and Statistics Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving Follow a series of instructions in sequential order (8G-4)	R
H3. Install and replace compressor	Graphing and Statistics Construct, read, and interpret displays of data (7F-2)	R

AIR CONDITIONING, HEATING, AND REFRIGERATION		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
H10. Perform cleanup of a contaminated system	Understanding Numbers	R
	• Communicate and Interpret numbers (8A-1)	
	Measurement	R
	• Solve problems involving measurement (10D-11)	
H11. Charge air conditioning system	Graphing and Statistics	R
	• Construct, read, and interpret displays of data (7F-2)	
	Problem Solving	R
	• Follow a series of instructions in sequential order (8G-4)	
H12. Check capacity of cooling system	Measurement	R
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	
	• Solve problems involving measurement (10D-11)	
	Graphing and Statistics	R
	• Construct, read, and interpret displays of data (7F-2)	
	Problem Solving	R
	• Follow a series of instructions in sequential order (8G-4)	
	Measurement	R
	• Compute the area and perimeter of irregularly shaped figures (9D-5)	
	• Solve problems involving measurement (volume) (9D-11)	
		R

AIR CONDITIONING, HEATING, AND REFRIGERATION		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
H13. Interpret wiring diagram - cooling system	Problem Solving Follow a series of instructions in sequential order (8G-4)	R
H14. Describe operation of a heat pump		
H15. Interpret wiring diagram - heat pump	Problem Solving Follow a series of instructions in sequential order (8G-4)	R
H16. Check capacity of heat pump	Measurement - Compute the area and perimeter of irregularly shaped figures (9D-5) - Solve problems involving measurement (volume) (9D-11)	R R
H17. Replace defrost system components - heat pump	Graphing and Statistics - Construct, read, and interpret displays of data (7F-2) Problem Solving - Follow a series of instructions in sequential order (8G-4)	R R
H18. Start and check a residential heating and cooling system	Graphing and Statistics Construct, read, and interpret displays of data (7F-2)	R

AIR CONDITIONING, HEATING, AND REFRIGERATION		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
H19. Describe concept of balance points	Measurement	R
	- Choose the appropriate unit of precision for a given measurement situation (7D-1) - Solve problems involving measurement (10D-11)	R
	Graphing and Statistics Construct, read, and interpret displays of data (7F-2)	R
H20. Identify and describe operation of heating system components		
H21. Interpret wiring diagrams - heating systems	Problem Solving Follow a series of instructions in sequential order (8G-4)	R
H22. Start and adjust a furnace	Measurement	R
	- Choose the appropriate unit of precision for a given measurement situation (7D-1) - Solve problems involving measurement (10D-11)	R
	Graphing and Statistics Construct, read, and interpret displays of data (7F-2)	R
H23. Check and adjust air flow	Measurement	R
	- Choose the appropriate unit of precision for a given measurement situation (7D-1) - Solve problems involving measurement (10D-11)	R
	Graphing and Statistics Construct, read, and interpret displays of data (7F-2)	R

AIR CONDITIONING, HEATING, AND REFRIGERATION		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
H24. Install and replace electric motor	Measurement	R
	- Choose the appropriate unit of precision for a given measurement situation (7D-1) - Solve problems involving measurement (10D-11)	R
	Graphing and Statistics	R
	Construct, read, and interpret displays of data (7F-2)	
H25. Repair, replace and service electronic air cleaner	Problem Solving	R
	Follow a series of instructions in sequential order (8G-4)	
	Measurement	R
	- Choose the appropriate unit of precision for a given measurement situation (7D-1) - Solve problems involving measurement (10D-11)	R
	Graphing and Statistics	R
	Construct, read, and interpret displays of data (7F-2)	
	Problem Solving	R
	Follow a series of instructions in sequential order (8G-4)	

AIR CONDITIONING, HEATING, AND REFRIGERATION		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
H26. Perform preventative maintenance	Measurement Solve problems involving measurement (10D-11)	R
	Graphing and Statistics Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving Follow a series of instructions in sequential order (8G-4)	R
H27. Pump down unit	Computation Compute the sum, difference, product, or quotient of intergers (8B-6)	R
	Measurement Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Problem Solving Follow a series of instructions in sequential order (8G-4)	R
H28. Remove and replace drier cartridge	Computation Compute the sum, difference, product, or quotient of intergers (8B-6)	R
	Measurement Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Problem Solving Follow a series of instructions in sequential order (8G-4)	R

AIR CONDITIONING, HEATING, AND REFRIGERATION		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
H29. Clean, repair and maintain cooling tower		
H30. Identify and use related tools and instruments	Measurement Solve problems involving measurement (10D-11)	R
	Graphing and Statistics Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving Follow a series of instructions in sequential order (8G-4)	R
I1. Perform systematic problem solving of an air system	Measurement Solve problems involving measurement (10D-11)	R
	Graphing and Statistics Construct, read, and interpret displays of data (7F-2)	R
	Calculate and interpret the probability of an event (8F-4)	R
	Problem Solving - State logical conclusions from given conditions (10G-1) - Follow a series of instructions in sequential order (8G-4)	R
	Consumer Problems Solve problems involving volume and area in consumer situations (9H-1)	R

AIR CONDITIONING, HEATING, AND REFRIGERATION		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
12. Perform systematic problem solving of an electrical system	Measurement	R
	Solve problems involving measurement (10D-11)	
	Graphing and Statistics	R
	- Construct, read, and interpret displays of data (7F-2) - Calculate and interpret the probability of an event (8F-4)	R
	Problem Solving	R
	- State logical conclusions from given conditions (10G-1) - Follow a series of instructions in sequential order (8G-4)	R
	Consumer Problems	R
	Solve problems involving volume and area in consumer situations (9H-1)	

AIR CONDITIONING, HEATING, AND REFRIGERATION		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
I3. Perform systematic problem solving of a fuel system	Measurement	R
	Solve problems involving measurement (10D-11)	
	Graphing and Statistics	R
	- Construct, read, and interpret displays of data (7F-2) - Calculate and interpret the probability of an event (8F-4)	R
	Problem Solving	R
	- State logical conclusions from given conditions (10G-1) - Follow a series of instructions in sequential order (8G-4)	R
	Consumer Problems	
	Solve problems involving volume and area in consumer situations (9H-1)	R

APPENDIX:

Additional Math Skills Information

Based on
1990 Core Competencies And Key Skills
For Missouri Schools

Mathematics
Grade 2-10

GRADE LEVEL 2	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
2	2 Compare whole numbers 3 Identify place value a the digit in the ones', tens', or hundreds' place b the place value of a given digit by name c the value of a digit in the ones', tens', or hundreds' place 4 Complete and create patterns a number b geometric c graphic 6 Identify fractional parts	2 Add whole numbers 3 Subtract whole numbers 7 Explore the use of open sentences to describe mathematical relationships a involving addition b involving subtraction c which represent given computational situations		3 Tell and record time	1 Describe, model, draw, and classify shapes a rectangles and squares b circles c triangles	2 Construct, read, and interpret displays of data a bar graphs b pictographs c other displays of data		2 Solve word problems involving addition 3 Solve word problems involving subtraction

GRADE LEVEL 3	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
3	2 Compare numbers a compare two numbers using < or > b order a set of numbers by magnitude 3 Identify place value a the digit in the ones', tens', hundreds', or thousands' place b the place value of a given digit by name c the value of a digit in the ones', tens', hundreds', or thousands' place 6 Identify fractional parts	4 Add and subtract whole numbers with regrouping 5 Multiply whole numbers 7 Explore the use of open sentences to describe mathematical relationships a involving addition b involving subtraction c involving multiplication and division d identify open sentences that represent given computational situations		3 Tell and record time a relate various recording conventions to each other 5 Measure length, weight (mass), volume, and capacity using nonstandard and standard units a nearest inch b nearest centimeter c nearest pound or kilogram d nearest cup, pint, quart, gallon, and liter	2 Identify cones, cylinders, spheres, pyramids, and cubes	2 Construct, read, and interpret displays of data a read bar graphs and pictographs b contrast displays of data c interpret displays of data 3 Locate points on a grid		2 Solve word problems involving addition and subtraction of money 4 Solve word problems using addition, subtraction, and multiplication

GRADE LEVEL 4	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
4	3 Identify place value a the digit in the ones', tens', hundreds', thousands', or ten thousands' place b the place value of a given digit by name through ten thousands c the value of a specified digit(s) through the ten thousands' place 6 Graph points representing fractions on a number line a select the fraction represented by a given point on a number line b select the point on a number line representing a given fraction	4 Add and subtract whole numbers with up to four addends 5 Multiply whole numbers (3-digit by 1-digit) 7 Use open sentences to express mathematical relationships a identify the open sentence which represents a computational situation involving addition and/or subtraction, and multiplication and/or division b identify the computational situation which represents an open sentence involving addition and/or subtraction and multiplication and/or division	3 Recognize a situation in which an estimate or an exact answer is appropriate	2 Estimate measurements including area and perimeter of regular and irregular regions 5 Measure lengths a to the nearest half inch b to the nearest centimeter	2 Explore properties of right angles	2 Construct, read, and interpret displays of data a select bar graphs and pictographs b contrast displays of data		2 Solve problems involving money management a with computational algorithms b which may require nonstandard strategies 4 Solve standard multi-step word problems, using one or more than one operation 5 Solve nonstandard word problems

GRADE LEVEL 5	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
5	2 Compare unit fractions a compare two fractions using < or > b order a set of fractions by magnitude 3 Compare decimals a compare two decimals using <, >, or = b order a set of decimals by magnitude 7 Apply number theory concepts a factors b multiples	5 Multiply and divide whole numbers (3-digit by 2-digit) 7 Solve number sentences a involving addition and subtraction with whole numbers and/or decimals b involving multiplication and division with whole numbers with 1-digit multipliers and divisors 8 Add and subtract like fractions	2 Use estimation strategies and mental computation to determine whether an answer is reasonable	2 Estimate measurements a linear measure b area, mass, and volume measures 6 Measure area and perimeter of regular and irregular regions using nonstandard and standard units 9 Convert units of measure within a system a metric system b English system	1 Identify properties of lines a intersecting, parallel, and perpendicular lines b vertical, horizontal, and diagonal (oblique) lines 4 Compare and classify geometric shapes and solids a similar figures b congruent figures c identify a figure with a specified number of lines of symmetry d regular polygons e right triangles	1 Systematically collect, organize, and describe data a best method for collecting data b accurate organization of given data c describe data using ratio and proportion 2 Construct, read, and interpret displays of data a identify graphs that accurately represent given data b interpret displays of data c construct displays of data		4 Solve standard multi-step word problems 5 Solve nonstandard word problems

GRADE LEVEL 6	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
6	2 Compare fractions and decimals a compare two fractions using $<$, $>$, or $=$ b compare two decimals using $<$, $>$, or $=$ c order a set of fractions or decimals by magnitude 4 Compare a numerical sequence 6 Graph points representing positive rational numbers on a number line a select the fraction or decimal represented by a given point b select the point representing a given fraction or decimal	6 Add, subtract, multiply, and divide whole numbers 7 Solve number sentences a involving whole numbers and decimals b involving whole numbers and like fractions 8 Multiply fractions a whole numbers and fractions b fractions with denominators less than 10 9 Use operations in the correct order		1 Choose an appropriate unit of measure and the corresponding tool for a given situation a within the metric system b within the English system 6 Calculate areas and perimeters a of squares and rectangles 9 Convert units of measure within a system a metric system b English system	4 Compare and classify geometric shapes and solids a similar figures b congruent figures c identify a figure with a specified number of lines of symmetry d regular polygons e right triangles	1 Systematically collect, organize, and describe data a best method for collecting data b accurate organization of given data 2 Construct, read, and interpret displays of data a identify graphs that accurately represent given data b interpret displays of data c construct displays of data		1 Solve word problems involving money 4 Solve standard multi-step word problems 5 Solve nonstandard word problems

GRADE LEVEL 7	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
7	1 Communicate and interpret numbers a interpret calculator displays b express numbers in scientific notation with positive exponents c express large numbers in conventional notation 2 Compare positive rational numbers a compare fraction to fraction b compare decimal to fraction 5 Use numerical relationships to describe and simplify numerical situations 7 Apply number theory concepts a classify numbers as prime or composite b factors c multiples d multiple classifications	1 Recall fraction/decimal/percent equivalents 7 Solve linear equations (number sentences) a one-step b two-step 8 Compute the sum, difference, product, or quotient of fractions 9 Use operations in correct order a with + and/or - and + b with + and/or - and x 12 Compute solutions of problems involving percents a calculate percent of a number b calculate percent one number is of another c calculate the whole when a percent is given	1 Determine a reasonable estimate 2 Use estimation strategies and mental computation to determine if an answer is reasonable 5 Solve problems utilizing estimation a utilizing percents b utilizing fractions c utilizing decimals	1 Choose the appropriate unit of precision for a given measurement situation a in metric measurements b in standard measurements 2 Estimate measurement 6 Approximate and/or calculate areas and perimeters of irregularly shaped regions 10 Investigate the relationships among circumference, area, and diameter of a circle 11 Solve problems involving measurement	1 Recognize properties and relationships of lines and angles 2 Classify polygons a classify regular polygons with five or more sides b classify irregular polygons with five or more sides c classify quadrilaterals 3 Determine lines of symmetry in natural and geometric figures a in a natural figure b in a plane geometric figure 5 Identify the plane geometric figures which form the surfaces of three dimensional projects	1 Systematically collect, organize, and classify data a collect and organize statistical data b describe the most appropriate measure c determine mean d determine median e determine mode f determine range 2 Construct, read, and interpret displays of data a construct graphic data displays b identify correctly constructed bar and line graphs, pie charts, pictographs, and scattergrams c interpret bar and line graphs, pie charts, pictographs, and scattergrams 3 Formulate and solve problems that involve collecting and analyzing data	1 Create a problem to illustrate a given numerical sentence 2 Write a number sentence to illustrate a problem 3 Identify unnecessary or missing numerical data in a word problem	2 Solve problems involving percent in consumer situations a sales tax b discount c commission 4 Solve problems using ratio and proportion in consumer situations a involving pricing b involving recipe conversion c involving medication dosage d involving relative distances between locations

GRADE LEVEL 8	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
8	1 Communicate and interpret numbers a convert rational numbers to scientific notation b convert scientific notation to rational numbers 2 Compare rational numbers a compare fraction to fraction b compare decimal to fraction 5 Use mathematical relationships to describe and simplify mathematical expressions 7 Apply number theory a determine powers b determine square roots c determine cube roots	6 Compute the sum, difference, product, or quotient of integers 7 Solve linear equations a one-step b two-step 9 Evaluate algebraic expressions, given values for the variables	2 Use estimation strategies and mental computation to determine if an answer is reasonable 5 Solve problems utilizing estimation a utilizing percents b utilizing fractions c utilizing decimals	2 Estimate measurement 6 Calculate the perimeter or the area of a triangle, rectangle, or square 10 Calculate the circumference or the area of a circle 11 Solve problems involving measurement	1 Recognize properties and relationships of lines and angles a identify bisectors b identify radii c identify diagonals d identify diameters e identify interior angles f identify exterior angles 2 Classify polygons a classify triangles by sides/angles b classify quadrilaterals (e.g., parallelogram, rectangle, rhombus, trapezoid) 3 Recognize similar and congruent figures 5 Visualize, draw, and construct geometric figures	3 Formulate and solve problems that involve collecting and analyzing data 4 Calculate and interpret the probability of an event	1 Create a word problem to illustrate a given equation, or write an equation to illustrate a given problem 4 Follow a series of instructions in sequential order a in a flow chart b in a diagram c in a narrative	1 Solve problems involving money in consumer situations a involving simple interest b involving total cost of installment purchases c involving total cost of purchases including sales tax d involving discounts e involving sale prices 3 Solve problems involving area and perimeter in consumer situations 4 Solve problems using proportion in consumer situations a involving pricing b involving recipe conversion c involving medication dosage d involving relative distances between locations

GRADE LEVEL 9	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
9	5 Use mathematical relationships to simplify expressions a mathematical expressions b algebraic expressions 7 Apply number theory concepts	2 Compute using scientific notation 7 Solve linear equations a one/two steps with integral coefficients and integral or rational solutions	2 Judge reasonableness of solutions or estimates of solutions to problems 4 Determine the relative magnitude of fractional numbers 5 Solve problems utilizing estimation a consumer situations b practical situations	5 Compute the area and perimeter of irregularly shaped figures 11 Solve problems involving measurement a volume of cylinders b volume of rectangular solids	1 Recognize properties and relationships of lines and angles 4 Determine if a given point is on the graph of a given equation 5 Visualize, draw, and construct geometric figures 6 Solve problems using measures of inclination: (slope)	2 Calculate and interpret the probability of an event 3 Formulate and solve problems that involve collecting and analyzing statistical data a draw inferences b evaluate conclusions c solve problems involving mean, median, mode, and range 4 Judge the reliability of inferences drawn from statistical data	1 Translate word phrases and sentences into algebraic expressions and equations 2 Evaluate the validity of conclusions drawn from given premises and definitions 3 Identify impediments to solving a given problem a information to solve a problem b information missing to solve a problem c information unnecessary to solve a problem d information that needs to be converted to another form	1 Solve problems involving volume and area in consumer situations 2 Solve problems using proportion in consumer situations a involving pricing b involving food, recipes, and nutrition c involving medication dosage d involving relative distances between locations 3 Investigate problems involving personal finance 4 Compute gross pay using hourly, monthly, commission, piecework, and/or overtime rates

GRADE LEVEL 10	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
10	5 Use mathematical relationships to simplify expressions - a mathematical expressions - b algebraic expressions	7 Solve linear equations - a with decimal coefficients - b with fractional coefficients - c with integral coefficients 10 Solve formulas for a given variable	1 Estimate solutions for various computational problems - a using scientific notation - b using whole numbers - c using fractions - d using decimals 2 Judge reasonableness of solutions 5 Solve problems utilizing estimation - a on consumer situations - b on practical situations	5 Solve problems requiring the application of the Pythagorean theorem - a given diagrams and measurements of right triangles - b given a situation involving a right triangle 11 Solve problems involving measurement	1 Recognize properties and relationships of lines and angles - a parallel and perpendicular lines - b complementary and supplementary angles - c alternate interior and corresponding angles - d calculate the third angle of a triangle 3 Graph equations - a plot the graph of a linear equation - b identify the graph of a linear equation - c identify the slope of a line given its graph and equation - d use the graph of a line to identify its equation 5 Visualize, draw, and construct geometric figures 6 Solve problems using the concepts of symmetry, similarity, and congruence - a determine lines of symmetry - b use the concept of congruence	2 Calculate and interpret the probability of an event 3 Identify limitations of an inference drawn from statistical data - a limitations to an inference - b additional information needed - c demonstrable bias	1 State logical conclusions from given conditions 2 Evaluate the acceptability of a conclusion drawn through logical inference	2 Solve banking problems related to maintaining a checking account 4 Use appropriate information and tables to compute net pay, considering Social Security deductions, state and federal taxes, etc.

INTEGRATING VOCATIONAL COMPETENCIES AND MATH SKILLS

AUTO COLLISION

Available from the
Instructional Materials Laboratory
University of Missouri-Columbia
10 London Hall
Columbia, Missouri 65211
314-882-2883
Catalog Number 65-7500-I

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FOREWORD

National interest and legislation support the need for identifying core competencies and key skills taught in industrial education classes. An understanding of the basic competencies involved will help identify academic subjects as they relate to specific occupations.

The following program area/math skills matrix can therefore be a valuable resource for program integration of academics, pre-testing and skills assessment, and special needs curriculum development. It identifies the math core competencies and key skills required for/taught in one of ten program areas at the Missouri secondary level. Matrices were developed for: Air Conditioning, Heating, and Refrigeration; Auto Collision Technology; Automotive Technology; Building Trades; Drafting; Electronics; Graphic Arts (Offset Lithography); Health Services Assistant; Machine Technology; and Welding.

The materials used to create the matrix include: the 1990 Core Competencies and Key Skills for Missouri Schools, grades two through ten; and Instructional Materials Laboratory vocational program competency profiles for the program areas involved.

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TO THE INSTRUCTOR: SUGGESTIONS FOR USE

The matrix that follows is divided into three columns. Reading in a row across all three of the columns will identify which math skills are involved in each vocational competency and tell whether the math skills are new to students or simply need reinforcement.

The first column identifies the vocational competencies involved in the program area. The numbers and competencies in this column refer to the Instructional Materials Laboratory competency profile for the program area.

The second column identifies which math skills are involved in the vocational competencies. The skills and numbers listed in this column refer to the 1990 Core Competencies and Key Skills for Missouri Schools, grades two through ten. (The list can also stand alone as a general list of math skills.) The column is blank for any vocational competency that the committee members decided did not require math skills.

Additional information about the math skills listed in the second column of the matrix may be found in the appendix following the matrix. The appendix is based on the math skills identified in the 1990 Core Competencies and Key Skills for Missouri Schools.

The last column tells whether the math skills will be new to students in the vocational classroom or whether they have been covered by math courses in the second through tenth grades. You may want to review and/or reinforce the math skills that students already have, and to make arrangements for them to learn the skills that are new to them.

As you use the matrix to help students learn or review math skills, keep in mind that different students learn in different ways. Efforts should be made to ensure that all students have an equal opportunity to understand and learn the material, regardless of race, color, national origin, gender, age, or disability.

Hold high expectations for all students, and provide the instruction necessary for students to meet those expectations. It is important that students achieve in math because research has shown a link between attitude toward mathematics and science, self-esteem levels, and career aspirations. According to a survey by the American Association of University Women: "Girls and boys who like mathematics and science have higher self-esteem, more ambitious career goals, and are more likely to hold onto their dreams."

As you help students achieve and develop this positive attitude toward mathematics, be aware that students of different genders give different reasons for their lack of interest in math. The AAUW survey states: "The gender differences in the intertwining of self-esteem and math/science interest is most evident in girls' and boys' reasons for their declining interest in math and science. While boys 'externalize' by seeing math and science as unimportant, girls 'internalize' by thinking themselves not smart enough."

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
A1. Identify opportunities in the auto body field		
A2. Identify the basic construction of the auto body	Problem Solving Follow a series of instructions in sequential order (8G-4)	R
B1. Read a rule, fractional-inch and metric	Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Estimate measurement (7D-2) - Solve problems involving measurement (7D-11)	R R R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
B2. Solve problems involving volume and ratios	Understanding Numbers Compare positive rational numbers (7A-2)	R
	Computation Solve formulas for a given variable (10B-10)	R
	Measurement Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Solve problems involving measurement (7D-11)	R
	Solve problems involving measurement (volume) (9D-11)	R
	Problem Solving Follow a series of instructions in sequential order (8G-4)	R
C1. Demonstrate safe use and maintenance of general hand tools	Consumer Problems Solve problems involving volume and area in consumer situations (9H-1)	R
	Solve problems using ratio and proportion in consumer situations (7H-4)	R
C1. Demonstrate safe use and maintenance of general hand tools	Problem Solving Follow a series of instructions in sequential order (8G-4)	R
C2. Demonstrate safe use and maintenance of auto body hand tools	Problem Solving Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
C3. Demonstrate safe use and maintenance of electric and pneumatic hand tools	Problem Solving Follow a series of instructions in sequential order (8G-4)	R
C4. Demonstrate safe use and maintenance of electric, pneumatic, and hydraulic equipment	Problem Solving Follow a series of instructions in sequential order (8G-4)	R
C5. Describe proper lifting and jacking techniques	Problem Solving Follow a series of instructions in sequential order (8G-4)	R
C6. Identify collision repair tools that are current with industry standards	Problem Solving Follow a series of instructions in sequential order (8G-4)	R
D1. Identify government agencies regulating the auto body industry (OSHA, EPA)	Problem Solving Follow a series of instructions in sequential order (8G-4)	R
D2. Identify general safety rules	Problem Solving Follow a series of instructions in sequential order (8G-4)	R
D3. Use protective clothing and equipment	Problem Solving Follow a series of instructions in sequential order (8G-4)	R
D4. Identify the proper use of fire protection equipment	Problem Solving Follow a series of instructions in sequential order (8G-4)	R
D5. Use chemicals safely	Problem Solving Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
D6. Identify environmental effects of chemicals	Problem Solving Follow a series of instructions in sequential order (8G-4)	R
D7. Identify proper chemical disposal techniques	Problem Solving Follow a series of instructions in sequential order (8G-4)	R
D8. Identify information on and importance of MSD sheets	Problem Solving Follow a series of instructions in sequential order (8G-4)	R
D9. Identify important toxic substances	Problem Solving Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
E1. Diagnose and analyze damage	Computation	
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	• Solve formulas for a given variable (10B-10)	R
	Estimation	
	• Determine a reasonable estimate (7C-1)	R
	• Use estimation strategies and mental computation to determine if an answer is reasonable (7C-2)	R
	• Judge reasonableness of solutions or estimates of solutions to problems (9C-2)	R
	• Judge reasonableness of solutions (10C-2)	R
	• Solve problems utilizing estimation (7C-5)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (7D-2)	R
	• Calculate the perimeter or the area of a triangle, rectangle, or square (8D-6)	R
	• Solve problems involving measurement (7D-11)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
E1. Diagnose and analyze damage (cont'd.)	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	• Formulate and solve problems that involve collecting and analyzing data (7F-3)	R
	Problem Solving	
	• Follow a series of instructions in sequential order (8G-4)	R
	Consumer Problems	
	• Solve problems involving volume and area in consumer situations (9H-1)	R
	• Solve problems involving area and perimeter in consumer situations (8H-3)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
E2. Use collision manuals	Computation	
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	• Solve formulas for a given variable (10B-10)	R
	Estimation	
	• Use estimation strategies and mental computation to determine if an answer is reasonable (7C-2)	R
	• Judge reasonableness of solutions or estimates of solutions to problems (9C-2)	R
	• Solve problems utilizing estimation (7C-5)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
E3. Write a damage report in logical sequence	Computation • Compute solutions of problems involving percents (7B-12)	R
	Estimation • Determine a reasonable estimate (7C-1)	R
	• Estimate solutions for various computational problems (10C-1)	R
	• Use estimation strategies and mental computation to determine if an answer is reasonable (7C-2)	R
	• Judge reasonableness of solutions or estimates of solutions to problems (9C-2)	R
	• Solve problems utilizing estimation (10C-5)	R
	Graphing and Statistics • Construct, read, and interpret displays of data (7F-2) • Formulate and solve problems that involve collecting and analyzing data (7F-3)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
E3. Write a damage report in logical sequence (cont'd.)	Problem Solving	
	• Write a number sentence to illustrate a problem (7G-2)	R
	• Evaluate the validity of conclusions drawn from given premises and definitions (9G-2)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Follow a series of instructions in sequential order (8G-4)	R
	Consumer Problems	
	• Solve problems involving money in consumer situations (8H-1)	R
	• Solve problems involving percent in consumer situations (7H-2)	R
F1. Identify auto body welding processes	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
F2. Use MIG welding safety procedures	Problem Solving	
	State logical conclusions from given conditions (10G-1)	R
	Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
F3. Set up equipment for MIG welding	Identify impediments to solving a given problem (9G-3)	R
	Graphing and Statistics	
	Construct, read, and interpret displays of data (7F-2)	R
	Formulate and solve problems that involve collecting and analyzing data (7F-3)	R
	Problem Solving	
	State logical conclusions from given conditions (10G-1)	R
	Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	Identify impediments to solving a given problem (9G-3)	R
	Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
F4. Prepare metal for MIG welding	Problem Solving - State logical conclusions from given conditions (10G-1) - Evaluate the acceptability of a conclusion drawn through logical inference (10G-2) - Identify impediments to solving a given problem (9G-3)	R R R
F5. Use weld-through primers	Problem Solving - State logical conclusions from given conditions (10G-1) - Evaluate the acceptability of a conclusion drawn through logical inference (10G-2) - Identify impediments to solving a given problem (9G-3)	R R R
F6. Construct a MIG plug weld	Problem Solving - State logical conclusions from given conditions (10G-1) - Evaluate the acceptability of a conclusion drawn through logical inference (10G-2) - Identify impediments to solving a given problem (9G-3)	R R R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
F7. Construct a MIG continuous weld	Problem Solving - State logical conclusions from given conditions (10G-1) - Evaluate the acceptability of a conclusion drawn through logical inference (10G-2) - Identify impediments to solving a given problem (9G-3)	R R R
F8. Construct a MIG stitch weld	Problem Solving - State logical conclusions from given conditions (10G-1) - Evaluate the acceptability of a conclusion drawn through logical inference (10G-2) - Identify impediments to solving a given problem (9G-3)	R R R
F9. Weld high strength steel unibody structural components	Problem Solving - State logical conclusions from given conditions (10G-1) - Evaluate the acceptability of a conclusion drawn through logical inference (10G-2) - Identify impediments to solving a given problem (9G-3)	R R R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
F10. Identify oxyacetylene welding safety procedures	Problem Solving	
	State logical conclusions from given conditions (10G-1)	R
	Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
F11. Set up and use equipment for oxyacetylene welding	Identify impediments to solving a given problem (9G-3)	R
	Graphing and Statistics	
	Construct, read, and interpret displays of data (7F-2)	R
	Formulate and solve problems that involve collecting and analyzing data (7F-3)	R
	Problem Solving	
	State logical conclusions from given conditions (10G-1)	R
	Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	Identify impediments to solving a given problem (9G-3)	R
	Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
F12. Set up and use equipment for oxyacetylene cutting	Graphing and Statistics	R
	• Construct, read, and interpret displays of data (7F-2)	R
	• Formulate and solve problems that involve collecting and analyzing data (7F-3)	
	Problem Solving	R
	• State logical conclusions from given conditions (10G-1)	R
F13. Use protective clothing and equipment	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R
	Problem Solving	R
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
G3. Roughout panel	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
G4. Shrink panel	• Follow a series of instructions in sequential order (8G-4)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
G5. Prepare surface for body filler	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
G6. Apply body filler	Estimation	
	• Determine a reasonable estimate (7C-1)	R
	• Solve problems utilizing estimation (7C-5)	R
	• Solve problems utilizing estimation (in practical situations) (10C-5)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (7D-2)	R
	• Solve problems involving measurement (7D-11)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
G7. Finish body filler	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
G8. Apply corrosion protection	• Follow a series of instructions in sequential order (8G-4)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
G9. Use weld-on stud gun to repair sheet metal	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
H1. Identify plastic types	• Follow a series of instructions in sequential order (8G-4)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
H2. Analyze damage	Problem Solving - State logical conclusions from given conditions (10G-1) - Evaluate the acceptability of a conclusion drawn through logical inference (10G-2) - Identify impediments to solving a given problem (9G-3) - Follow a series of instructions in sequential order (8G-4)	 R R R R
H3. Clean exterior and interior surfaces	Problem Solving - State logical conclusions from given conditions (10G-1) - Evaluate the acceptability of a conclusion drawn through logical inference (10G-2) - Identify impediments to solving a given problem (9G-3) - Follow a series of instructions in sequential order (8G-4)	 R R R R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
H4. Perform chemical plastic welding	Measurement Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Graphing and Statistics Construct, read, and interpret displays of data (7F-2)	R
	Formulate and solve problems that involve collecting and analyzing data (7F-3)	R
	Problem Solving State logical conclusions from given conditions (10G-1)	R
	- Evaluate the acceptability of a conclusion drawn through logical inference (10G-2) - Identify impediments to solving a given problem (9G-3) - Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
H5. Perform airless plastic welding	Problem Solving - State logical conclusions from given conditions (10G-1) - Evaluate the acceptability of a conclusion drawn through logical inference (10G-2) - Identify impediments to solving a given problem (9G-3) - Follow a series of instructions in sequential order (8G-4)	R R R R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
H6. Repair plastic with chemical fillers	Measurement Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Graphing and Statistics Construct, read, and interpret displays of data (7F-2)	R
	Formulate and solve problems that involve collecting and analyzing data (7F-3)	R
	Problem Solving State logical conclusions from given conditions (10G-1)	R
	- Evaluate the acceptability of a conclusion drawn through logical inference (10G-2) - Identify impediments to solving a given problem (9G-3) - Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
H9. Identify composite panel repair procedures	Problem Solving - State logical conclusions from given conditions (10G-1) - Evaluate the acceptability of a conclusion drawn through logical inference (10G-2) - Identify impediments to solving a given problem (9G-3) - Follow a series of instructions in sequential order (8G-4)	 R R R R
H10. Identify composite repair tools and adhesives	Problem Solving - State logical conclusions from given conditions (10G-1) - Evaluate the acceptability of a conclusion drawn through logical inference (10G-2) - Identify impediments to solving a given problem (9G-3) - Follow a series of instructions in sequential order (8G-4)	 R R R R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
H11. Repair composite panels with adhesives	Measurement	R
	Choose the appropriate unit of precision for a given measurement situation (7D-1)	
	Graphing and Statistics	R
	- Construct, read, and interpret displays of data (7F-2) - Formulate and solve problems that involve collecting and analyzing data (7F-3)	R
	Problem Solving	R
	- State logical conclusions from given conditions (10G-1) - Evaluate the acceptability of a conclusion drawn through logical inference (10G-2) - Identify impediments to solving a given problem (9G-3) - Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
H12. Repair holes in SMC body panels	Computation • Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement • Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Graphing and Statistics • Construct, read, and interpret displays of data (7F-2)	R
	• Formulate and solve problems that involve collecting and analyzing data (7F-3)	R
	Problem Solving • State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
H13. Section SMC body panels	Computation • Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement • Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Graphing and Statistics • Construct, read, and interpret displays of data (7F-2)	R
	• Formulate and solve problems that involve collecting and analyzing data (7F-3)	R
	Problem Solving • State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
H14. Remove and replace complete SMC body panels	Computation • Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement • Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Graphing and Statistics • Construct, read, and interpret displays of data (7F-2)	R
	• Formulate and solve problems that involve collecting and analyzing data (7F-3)	R
	Problem Solving • State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
I1. Identify safety procedures when working with fiberglass	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
I2. Analyze damage	• Follow a series of instructions in sequential order (8G-4)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
I3. Prepare exterior and interior surfaces	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
14. Reconstruct fiberglass panels	Computation	
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	• Formulate and solve problems that involve collecting and analyzing data (7F-3)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
I5. Section fiberglass panels	Computation	
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	• Formulate and solve problems that involve collecting and analyzing data (7F-3)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
J1. Remove and replace cosmetic panels, welded on	Computation	
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
J2. Remove and replace structural panels, welded on	Computation	
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
J3. Remove and replace cosmetic panels, bolted on	Computation	
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
J4. Section non-structural panels, welded on	Computation	
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
J5. Replace door intrusion barrier	Computation • Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement • Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R
	Problem Solving • State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2) • Identify impediments to solving a given problem (9G-3) • Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
J6. Replace bonded door panels	Computation	
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
K1. Remove and replace bumpers, steel or aluminum	Computation	
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
K2. Replace energy absorbers	Computation • Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement • Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R
	Problem Solving • State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2) • Identify impediments to solving a given problem (9G-3) • Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
K3. Remove and replace soft fascia covers	Computation	
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
K4. Repair soft fascia covers	Computation	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	
	Measurement	R
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	
	• Solve problems involving measurement (7D-11)	R
	Problem Solving	R
L1. Identify refinishing equipment	• State logical conclusions from given conditions (10G-1)	
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R
	Problem Solving	R
	• State logical conclusions from given conditions (10G-1)	
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R
	Problem Solving	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
L4. Service and maintain a spray gun	Problem Solving • State logical conclusions from given conditions (10G-1) • Evaluate the acceptability of a conclusion drawn through logical inference (10G-2) • Identify impediments to solving a given problem (9G-3) • Follow a series of instructions in sequential order (8G-4)	R R R R
L5. Service and maintain the paint room	Problem Solving • State logical conclusions from given conditions (10G-1) • Evaluate the acceptability of a conclusion drawn through logical inference (10G-2) • Identify impediments to solving a given problem (9G-3) • Follow a series of instructions in sequential order (8G-4)	R R R R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
M2. Strip painted surfaces using chemicals	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
M3. Demonstrate appropriate masking techniques	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
M6. Demonstrate appropriate sanding techniques	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
M7. Select and apply appropriate primer/primer surfacer/sealant	• Follow a series of instructions in sequential order (8G-4)	R
	Measurement	
	• Solve problems involving measurement (volume) (9D-11)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
M8. Perform guide coat/block sanding/reprime	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
M9. Identify topcoats and topcoat application procedures	• Follow a series of instructions in sequential order (8G-4)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
M10. Mix and apply acrylic lacquer system	Computation	
	• Recall fraction/decimal/percent equivalents (7B-1)	R
	• Solve formulas for a given variable (10B-10)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R
	• Solve problems involving measurement (volume) (9D-11)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R
	Consumer Problems	
	• Solve problems using ratio and proportion in consumer situations (7H-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
M11. Mix and apply acrylic enamel system	Computation	
	• Recall fraction/decimal/percent equivalents (7B-1)	R
	• Solve formulas for a given variable (10B-10)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R
	• Solve problems involving measurement (volume) (9D-11)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R
	Consumer Problems	
	• Solve problems using ratio and proportion in consumer situations (7H-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
M12. Mix and apply urethane enamel system	Computation	
	• Recall fraction/decimal/percent equivalents (7B-1)	R
	• Solve formulas for a given variable (10B-10)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R
	• Solve problems involving measurement (volume) (9D-11)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R
	Consumer Problems	
	• Solve problems using ratio and proportion in consumer situations (7H-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
M13. Mix and apply basecoat/clearcoat system	Computation	
	• Recall fraction/decimal/percent equivalents (7B-1)	R
	• Solve formulas for a given variable (10B-10)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R
	• Solve problems involving measurement (volume) (9D-11)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R
	Consumer Problems	
	• Solve problems using ratio and proportion in consumer situations (7H-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
M14. Tint and blend color coat	Computation	
	• Recall fraction/decimal/percent equivalents (7B-1)	R
	• Solve formulas for a given variable (10B-10)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R
	• Solve problems involving measurement (volume) (9D-11)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R
	Consumer Problems	
	• Solve problems using ratio and proportion in consumer situations (7H-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
M15. Apply chip-resistant coating	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R
	• Solve problems involving measurement (volume) (9D-11)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
M16. Mix and apply flexible paint system	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R
	• Solve problems involving measurement (volume) (9D-11)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
M17. Apply tri-coat paints	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R
	• Solve problems involving measurement (volume) (9D-11)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
M18. Perform clearcoat repair without refinishing	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
M19. Perform clearcoat repair by refinishing	Measurement	R
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	
	• Solve problems involving measurement (7D-11)	R
	• Solve problems involving measurement (volume) (9D-11)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
M20. Perform paint detailing after refinishing	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
N1. Identify types of bolts and nuts, US and metric	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
N2. Identify types of rivets	• Follow a series of instructions in sequential order (8G-4)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
N3. Identify types of screws	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
N4. Identify types of clips	• Follow a series of instructions in sequential order (8G-4)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
O4. Locate and drill holes for molding and trim	Computation	
	• Recall fraction/decimal/percent equivalents (7B-1)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R
	• Determine lines of symmetry in natural and geometric figures (7E-3)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	• Formulate and solve problems that involve collecting and analyzing data (7F-3)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
P2. Repair vinyl tops (cont'd.)	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	• Formulate and solve problems that involve collecting and analyzing data (7F-3)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
P3. Refinish vinyl tops	Computation	
	• Recall fraction/decimal/percent equivalents (7B-1)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R
	• Solve problems involving measurement (volume) (9D-11)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	• Formulate and solve problems that involve collecting and analyzing data (7F-3)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
Q2. Clean plain interior fabrics	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
Q3. Clean coated interior fabrics, genuine leather and molded plastic interior components	• Follow a series of instructions in sequential order (8G-4)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
Q4. Clean polyurethane foam interior components	Problem Solving • State logical conclusions from given conditions (10G-1) • Evaluate the acceptability of a conclusion drawn through logical inference (10G-2) • Identify impediments to solving a given problem (9G-3) • Follow a series of instructions in sequential order (8G-4)	R R R R
Q5. Clean painted interior surfaces	Problem Solving • State logical conclusions from given conditions (10G-1) • Evaluate the acceptability of a conclusion drawn through logical inference (10G-2) • Identify impediments to solving a given problem (9G-3) • Follow a series of instructions in sequential order (8G-4)	R R R R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
Q6. Clean black-rubber interior surfaces and weatherstrip	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
Q7. Remove and replace seats	Follow a series of instructions in sequential order (8G-4)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
Q8. Remove and replace seat tracks	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
Q9. Remove and reinstall dash	• Follow a series of instructions in sequential order (8G-4)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
Q10. Remove and reinstall heating and air conditioning assembly	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
Q11. Remove and reinstall carpeting	• Follow a series of instructions in sequential order (8G-4)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
Q12. Remove and reinstall seat belts and shoulder harness	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
Q13. Identify supplemental inflatable restraint systems	• Follow a series of instructions in sequential order (8G-4)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
Q14. Diagnose supplemental inflatable restraint systems	Problem Solving • State logical conclusions from given conditions (10G-1) • Evaluate the acceptability of a conclusion drawn through logical inference (10G-2) • Identify impediments to solving a given problem (9G-3) • Follow a series of instructions in sequential order (8G-4)	R R R R
Q15. Service and repair supplemental inflatable restraint systems	Problem Solving • State logical conclusions from given conditions (10G-1) • Evaluate the acceptability of a conclusion drawn through logical inference (10G-2) • Identify impediments to solving a given problem (9G-3) • Follow a series of instructions in sequential order (8G-4)	R R R R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
R3. Remove and replace a gasket-type window or back glass	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
R4. Remove and replace glass with urethane sealants	• Follow a series of instructions in sequential order (8G-4)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
R5. Remove and replace glass with butyl tape kit	Problem Solving - State logical conclusions from given conditions (10G-1) - Evaluate the acceptability of a conclusion drawn through logical inference (10G-2) - Identify impediments to solving a given problem (9G-3) - Follow a series of instructions in sequential order (8G-4)	 R R R R
R6. Install bonded mirror brackets to windshield	Problem Solving - State logical conclusions from given conditions (10G-1) - Evaluate the acceptability of a conclusion drawn through logical inference (10G-2) - Identify impediments to solving a given problem (9G-3) - Follow a series of instructions in sequential order (8G-4)	 R R R R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
R11. Remove and replace a door glass regulator	Problem Solving - State logical conclusions from given conditions (10G-1) - Evaluate the acceptability of a conclusion drawn through logical inference (10G-2) - Identify impediments to solving a given problem (9G-3) - Follow a series of instructions in sequential order (8G-4)	 R R R R
R12. Inspect power windows	Problem Solving - State logical conclusions from given conditions (10G-1) - Evaluate the acceptability of a conclusion drawn through logical inference (10G-2) - Identify impediments to solving a given problem (9G-3) - Follow a series of instructions in sequential order (8G-4)	 R R R R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
S1. Identify electrical system components	Problem Solving - State logical conclusions from given conditions (10G-1) - Evaluate the acceptability of a conclusion drawn through logical inference (10G-2) - Identify impediments to solving a given problem (9G-3) - Follow a series of instructions in sequential order (8G-4)	R R R R

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AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
S2. Service a battery	Computation	
	• Add and subtract whole numbers with up to four addends (4B-4)	R
	• Multiply and divide whole numbers (3-digit by 2-digit) (5B-5)	R
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Measurement	
	• Solve problems involving measurement (7D-11)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
S3. Splice a wire	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
S4. Diagnose and repair electrical accessories	Computation	
	• Add and subtract whole numbers with up to four addends (4B-4)	R
	• Multiply and divide whole numbers (3-digit by 2-digit) (5B-5)	R
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
T1. Service a taillight assembly	Computation	
	• Add and subtract whole numbers with up to four addends (4B-4)	R
	• Multiply and divide whole numbers (3-digit by 2-digit) (5B-5)	R
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
T2. Service a headlight assembly	Computation	
	• Add and subtract whole numbers with up to four addends (4B-4)	R
	• Multiply and divide whole numbers (3-digit by 2-digit) (5B-5)	R
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
T3. Service mechanical headlights and covers	Computation	
	• Add and subtract whole numbers with up to four addends (4B-4)	R
	• Multiply and divide whole numbers (3-digit by 2-digit) (5B-5)	R
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
T4. Aim headlights using mechanical aiming equipment	Computation	
	• Add and subtract whole numbers with up to four addends (4B-4)	R
	• Multiply and divide whole numbers (3-digit by 2-digit) (5B-5)	R
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (7D-2)	R
	• Solve problems involving measurement (7D-11)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	• Formulate and solve problems that involve collecting and analyzing data (7F-3)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
T4. Aim headlights using mechanical aiming equipment (cont'd.)	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
U1. Remove and replace a radiator	• Follow a series of instructions in sequential order (8G-4)	R
	Computation	
	• Add and subtract whole numbers with up to four addends (4B-4)	R
	• Multiply and divide whole numbers (3-digit by 2-digit) (5B-5)	R
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
U2. Remove, inspect and replace V-Belts	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
U3. Test antifreeze solution	• Follow a series of instructions in sequential order (8G-4)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	• Formulate and solve problems that involve collecting and analyzing data (7F-3)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
U4. Service fan blades and clutches	Computation	
	• Add and subtract whole numbers with up to four addends (4B-4)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Problem Solving	
U5. Check and service radiator and heater hoses	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
U6. Inspect, repair, and replace auxiliary oil cooler	Graphing and Statistics	R
	Construct, read, and interpret displays of data (7F-2)	
	Problem Solving	R
	- State logical conclusions from given conditions (10G-1) - Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	- Identify impediments to solving a given problem (9G-3) - Follow a series of instructions in sequential order (8G-4)	R
U7. Inspect, repair, and replace fuel, exhaust, and emissions systems	Problem Solving	R
	- State logical conclusions from given conditions (10G-1) - Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	- Identify impediments to solving a given problem (9G-3) - Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
V1. Identify air conditioning system components and service procedures	Measurement	R
	Solve problems involving measurement (7D-11)	
	Graphing and Statistics	R
	Construct, read, and interpret displays of data (7F-2)	
	Problem Solving	R
	State logical conclusions from given conditions (10G-1)	
	Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	Identify impediments to solving a given problem (9G-3)	R
	Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
V2. Replace condenser	Graphing and Statistics Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving State logical conclusions from given conditions (10G-1)	R
	Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	Identify impediments to solving a given problem (9G-3)	R
	Follow a series of instructions in sequential order (8G-4)	R
	Consumer Problems Solve problems involving money in consumer situations (8H-1)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
V3. Remove and reinstall compressor	Graphing and Statistics Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving State logical conclusions from given conditions (10G-1)	R
	Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	Identify impediments to solving a given problem (9G-3)	R
	Follow a series of instructions in sequential order (8G-4)	R
	Consumer Problems Solve problems involving money in consumer situations (8H-1)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
V4. Test the system for leaks	Measurement	
	• Convert units of measure within a system (6D-9)	R
	• Solve problems involving measurement (7D-11)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	• Formulate and solve problems that involve collecting and analyzing data (7F-3)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
V5. Repair leaks in air conditioning system	Measurement Solve problems involving measurement (7D-11)	R
	Problem Solving State logical conclusions from given conditions (10G-1)	R
	Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	Identify impediments to solving a given problem (9G-3)	R
	Follow a series of instructions in sequential order (8G-4)	R
	Consumer Problems Solve problems using ratio and proportion in consumer situations (7H-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
V6. Evacuate and charge system using vacuum pump or charging system	Graphing and Statistics	R
	• Construct, read, and interpret displays of data (7F-2)	R
	• Formulate and solve problems that involve collecting and analyzing data (7F-3)	R
	Problem Solving	R
	• State logical conclusions from given conditions (10G-1)	R
V7. Check and service air conditioning hoses	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R
	Problem Solving	R
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
V8. Inspect, flush, and replace heater core	Problem Solving - State logical conclusions from given conditions (10G-1) - Evaluate the acceptability of a conclusion drawn through logical inference (10G-2) - Identify impediments to solving a given problem (9G-3) - Follow a series of instructions in sequential order (8G-4)	R R R R
W1. Identify front suspension systems	Problem Solving - State logical conclusions from given conditions (10G-1) - Evaluate the acceptability of a conclusion drawn through logical inference (10G-2) - Identify impediments to solving a given problem (9G-3) - Follow a series of instructions in sequential order (8G-4)	R R R R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
W2. Identify rear suspension systems	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
W3. Remove and reinstall front suspension systems	• Follow a series of instructions in sequential order (8G-4)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
W4. Remove and reinstall rear suspension systems	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
W5. Remove and reinstall front drive train	• Follow a series of instructions in sequential order (8G-4)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
W6. Service suspension systems	Problem Solving - State logical conclusions from given conditions (10G-1) - Evaluate the acceptability of a conclusion drawn through logical inference (10G-2) - Identify impediments to solving a given problem (9G-3) - Follow a series of instructions in sequential order (8G-4)	R R R R
W7. Identify steering systems	Problem Solving - State logical conclusions from given conditions (10G-1) - Evaluate the acceptability of a conclusion drawn through logical inference (10G-2) - Identify impediments to solving a given problem (9G-3) - Follow a series of instructions in sequential order (8G-4)	R R R R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
W8. Perform four-wheel alignment	Computation	
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Calculate the perimeter or the area of a triangle, rectangle, or square (8D-6)	R
	• Convert units of measure within a system (6D-9)	R
	• Solve problems involving measurement (7D-11)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R
	• Determine lines of symmetry in natural and geometric figures (7E-3)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	• Formulate and solve problems that involve collecting and analyzing data (7F-3)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
W8. Perform four-wheel alignment (cont'd.)	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
W9. Perform suspension quick checks	• Follow a series of instructions in sequential order (8G-4)	R
	Geometry	
	• Determine lines of symmetry in natural and geometric figures (7E-3)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
W10. Service power steering system	Problem Solving • State logical conclusions from given conditions (10G-1) • Evaluate the acceptability of a conclusion drawn through logical inference (10G-2) • Identify impediments to solving a given problem (9G-3) • Follow a series of instructions in sequential order (8G-4)	R R R R
W11. Service brake system	Problem Solving • State logical conclusions from given conditions (10G-1) • Evaluate the acceptability of a conclusion drawn through logical inference (10G-2) • Identify impediments to solving a given problem (9G-3) • Follow a series of instructions in sequential order (8G-4)	R R R R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
W12. Identify causes of uneven tire wear	Geometry	R
	Determine lines of symmetry in natural and geometric figures (7E-3)	
	Problem Solving	R
	- State logical conclusions from given conditions (10G-1) - Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	- Identify impediments to solving a given problem (9G-3) - Follow a series of instructions in sequential order (8G-4)	R
W13. Inspect, repair, and replace steering system components	Problem Solving	R
	- State logical conclusions from given conditions (10G-1) - Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	- Identify impediments to solving a given problem (9G-3) - Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
X1. Identify vehicle frame construction, conventional and unibody	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
X2. Identify frame and unibody terminology	• Follow a series of instructions in sequential order (8G-4)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
X3. Identify the 5 types of damage	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	• Formulate and solve problems that involve collecting and analyzing data (7F-3)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
X4. Use and interpret specification manuals	Computation	
	• Recall fraction/decimal/percent equivalents (7B-1)	R
	• Compute the sum, difference, product, or quotient of integers (8B-6)	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R
	• Convert units of measure within a system (6D-9)	R
	• Solve problems involving measurement (7D-11)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	• Formulate and solve problems that involve collecting and analyzing data (7F-3)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
X4. Use and interpret specification manuals (cont'd.)	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
X5. Identify characteristics and uses of high strength steel	• Follow a series of instructions in sequential order (8G-4)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
X6. Analyze damage using datum gauge	Computation	
	• Recall fraction/decimal/percent equivalents (7B-1)	R
	• Compute the sum, difference, product, or quotient of integers (8B-6)	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Estimation	
	• Determine a reasonable estimate (7C-1)	R
	• Estimate solutions for various computational problems (10C-1)	R
	• Use estimation strategies and mental computation to determine if an answer is reasonable (7C-2)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R
	• Convert units of measure within a system (6D-9)	R
	• Solve problems involving measurement (7D-11)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R
	• Determine lines of symmetry in natural and geometric figures (7E-3)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
X6. Analyze damage using datum gauge (cont'd.)	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	• Formulate and solve problems that involve collecting and analyzing data (7F-3)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
X7. Analyze damage using tram gauge and tape measure	Computation	
	• Recall fraction/decimal/percent equivalents (7B-1)	R
	• Compute the sum, difference, product, or quotient of integers (8B-6)	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Estimation	
	• Determine a reasonable estimate (7C-1)	R
	• Estimate solutions for various computational problems (10C-1)	R
	• Use estimation strategies and mental computation to determine if an answer is reasonable (7C-2)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R
	• Convert units of measure within a system (6D-9)	R
	• Solve problems involving measurement (7D-11)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R
	• Determine lines of symmetry in natural and geometric figures (7E-3)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
X7. Analyze damage using tram gauge and tape measure (cont'd.)	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	• Formulate and solve problems that involve collecting and analyzing data (7F-3)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
X8. Analyze damage using universal measuring system	Computation	
	• Recall fraction/decimal/percent equivalents (7B-1)	R
	• Compute the sum, difference, product, or quotient of integers (8B-6)	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Estimation	
	• Determine a reasonable estimate (7C-1)	R
	• Estimate solutions for various computational problems (10C-1)	R
	• Use estimation strategies and mental computation to determine if an answer is reasonable (7C-2)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R
	• Convert units of measure within a system (6D-9)	R
	• Solve problems involving measurement (7D-11)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R
	• Determine lines of symmetry in natural and geometric figures (7E-3)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
X8. Analyze damage using universal measuring system (cont'd.)	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	• Formulate and solve problems that involve collecting and analyzing data (7F-3)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
X9. Analyze damage using dedicated measuring system	Computation	
	• Recall fraction/decimal/percent equivalents (7B-1)	R
	• Compute the sum, difference, product, or quotient of integers (8B-6)	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Estimation	
	• Determine a reasonable estimate (7C-1)	R
	• Estimate solutions for various computational problems (10C-1)	R
	• Use estimation strategies and mental computation to determine if an answer is reasonable (7C-2)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R
	• Convert units of measure within a system (6D-9)	R
	• Solve problems involving measurement (7D-11)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R
	• Determine lines of symmetry in natural and geometric figures (7E-3)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
X9. Analyze damage using dedicated measuring system (cont'd.)	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	• Formulate and solve problems that involve collecting and analyzing data (7F-3)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
Y1. Straighten and align structural damage	Computation	
	• Recall fraction/decimal/percent equivalents (7B-1)	R
	• Compute the sum, difference, product, or quotient of integers (8B-6)	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Estimation	
	• Determine a reasonable estimate (7C-1)	R
	• Estimate solutions for various computational problems (10C-1)	R
	• Use estimation strategies and mental computation to determine if an answer is reasonable (7C-2)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R
	• Solve problems involving measurement (7D-11)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
Y1. Straighten and align structural damage (cont'd.)	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R
	• Determine lines of symmetry in natural and geometric figures (7E-3)	R
	• Solve problems using the concepts of symmetry, similarity, and congruence (10E-6)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	• Formulate and solve problems that involve collecting and analyzing data (7F-3)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
Y2. Replace component parts	Computation	
	• Recall fraction/decimal/percent equivalents (7B-1)	R
	• Compute the sum, difference, product, or quotient of integers (8B-6)	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Estimation	
	• Determine a reasonable estimate (7C-1)	R
	• Estimate solutions for various computational problems (10C-1)	R
	• Use estimation strategies and mental computation to determine if an answer is reasonable (7C-2)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R
	• Solve problems involving measurement (7D-11)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
Y2. Replace component parts (cont'd.)	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R
	• Determine lines of symmetry in natural and geometric figures (7E-3)	R
	• Solve problems using the concepts of symmetry, similarity, and congruence (10E-6)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	• Formulate and solve problems that involve collecting and analyzing data (7F-3)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
Y3. Perform stress relief using shock	Computation	
	• Recall fraction/decimal/percent equivalents (7B-1)	R
	• Compute the sum, difference, product, or quotient of integers (8B-6)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
Y4. Perform stress relief using heat	Computation	
	• Recall fraction/decimal/percent equivalents (7B-1)	R
	• Compute the sum, difference, product, or quotient of integers (8B-6)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
Y5. Replace high strength steel	Computation	
	• Recall fraction/decimal/percent equivalents (7B-1)	R
	• Compute the sum, difference, product, or quotient of integers (8B-6)	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Estimation	
	• Determine a reasonable estimate (7C-1)	R
	• Estimate solutions for various computational problems (10C-1)	R
	• Use estimation strategies and mental computation to determine if an answer is reasonable (7C-2)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R
	• Solve problems involving measurement (8D-11)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
Y5. Replace high strength steel (cont'd.)	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R
	• Determine lines of symmetry in natural and geometric figures (7E-3)	R
	• Solve problems using the concepts of symmetry, similarity, and congruence (10E-6)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	• Formulate and solve problems that involve collecting and analyzing data (7F-3)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
Y6. Section component parts	Computation	
	• Recall fraction/decimal/percent equivalents (7B-1)	R
	• Compute the sum, difference, product, or quotient of integers (8B-6)	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Estimation	
	• Determine a reasonable estimate (7C-1)	R
	• Estimate solutions for various computational problems (10C-1)	R
	• Use estimation strategies and mental computation to determine if an answer is reasonable (7C-2)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R
	• Solve problems involving measurement (7D-11)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
Y6. Section component parts (cont'd.)	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R
	• Determine lines of symmetry in natural and geometric figures (7E-3)	R
	• Solve problems using the concepts of symmetry, similarity, and congruence (10E-6)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	• Formulate and solve problems that involve collecting and analyzing data (7F-3)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
Y7. Remove and reinstall mechanical components	Computation	
	• Recall fraction/decimal/percent equivalents (7B-1)	R
	• Compute the sum, difference, product, or quotient of integers (8B-6)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
Y8. Repair space-age frames on plastic body vehicles	Computation	
	• Recall fraction/decimal/percent equivalents (7B-1)	R
	• Compute the sum, difference, product, or quotient of integers (8B-6)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R
	• Solve problems involving measurement (7D-11)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R
	• Determine lines of symmetry in natural and geometric figures (7E-3)	R
	• Solve problems using the concepts of symmetry, similarity, and congruence (10E-6)	R

AUTO COLLISION TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
Y8. Repair space-age frames on plastic body vehicles (cont'd.)	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

APPENDIX:

Additional Math Skills Information

Based on
1990 Core Competencies And Key Skills
For Missouri Schools

Mathematics
Grade 2-10

GRADE LEVEL 2	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
2	2 Compare whole numbers 3 Identify place value a the digit in the ones', tens', or hundreds' place b the place value of a given digit by name c the value of a digit in the ones', tens', or hundreds' place 4 Complete and create patterns a number b geometric c graphic 6 Identify fractional parts	2 Add whole numbers 3 Subtract whole numbers 7 Explore the use of open sentences to describe mathematical relationships a involving addition b involving subtraction c which represent given computational situations		3 Tell and record time	1 Describe, model, draw, and classify shapes a rectangles and squares b circles c triangles	2 Construct, read, and interpret displays of data a bar graphs b pictographs c other displays of data		2 Solve word problems involving addition 3 Solve word problems involving subtraction

GRADE LEVEL 3	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
3	2 Compare numbers a compare two numbers using < or > b order a set of numbers by magnitude 3 Identify place value a the digit in the ones', tens', hundreds', or thousands' place b the place value of a given digit by name c the value of a digit in the ones', tens', hundreds', or thousands' place 6 Identify fractional parts	4 Add and subtract whole numbers with regrouping 5 Multiply whole numbers 7 Explore the use of open sentences to describe mathematical relationships a involving addition b involving subtraction c involving multiplication and division d identify open sentences that represent given computational situations		3 Tell and record time a relate various recording conventions to each other 5 Measure length, weight (mass), volume, and capacity using nonstandard and standard units a nearest inch b nearest centimeter c nearest pound or kilogram d nearest cup, pint, quart, gallon, and liter	2 Identify cones, cylinders, spheres, pyramids, and cubes	2 Construct, read, and interpret displays of data a read bar graphs and pictographs b contrast displays of data c interpret displays of data 3 Locate points on a grid		2 Solve word problems involving addition and subtraction of money 4 Solve word problems using addition, subtraction, and multiplication

GRADE LEVEL 4	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
4	3 Identify place value a the digit in the ones', tens', hundreds', thousands', or ten thousands' place b the place value of a given digit by name through ten thousands c the value of a specified digit(s) through the ten thousands' place 6 Graph points representing fractions on a number line a select the fraction represented by a given point on a number line b select the point on a number line representing a given fraction	4 Add and subtract whole numbers with up to four addends 5 Multiply whole numbers (3-digit by 1-digit) 7 Use open sentences to express mathematical relationships a identify the open sentence which represents a computational situation involving addition and/or subtraction, and multiplication and/or division b identify the computational situation which represents an open sentence involving addition and/or subtraction and multiplication and/or division	3 Recognize a situation in which an estimate or an exact answer is appropriate	2 Estimate measurements including area and perimeter of regular and irregular regions 5 Measure lengths a to the nearest half inch b to the nearest centimeter	2 Explore properties of right angles	2 Construct, read, and interpret displays of data a select bar graphs and pictographs b contrast displays of data		2 Solve problems involving money management a with computational algorithms b which may require nonstandard strategies 4 Solve standard multi-step word problems, using one or more than one operation 5 Solve nonstandard word problems

GRADE LEVEL 5	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
5	2 Compare unit fractions a compare two fractions using < or > b order a set of fractions by magnitude 3 Compare decimals a compare two decimals using <, >, or = b order a set of decimals by magnitude 7 Apply number theory concepts a factors b multiples	5 Multiply and divide whole numbers (3-digit by 2-digit) 7 Solve number sentences a involving addition and subtraction with whole numbers and/or decimals b involving multiplication and division with whole numbers with 1-digit multipliers and divisors 8 Add and subtract like fractions	2 Use estimation strategies and mental computation to determine whether an answer is reasonable	2 Estimate measurements a linear measure b area, mass, and volume measures 6 Measure area and perimeter of regular and irregular regions using nonstandard and standard units 9 Convert units of measure within a system a metric system b English system	1 Identify properties of lines a intersecting, parallel, and perpendicular lines b vertical, horizontal, and diagonal (oblique) lines 4 Compare and classify geometric shapes and solids a similar figures b congruent figures c identify a figure with a specified number of lines of symmetry d regular polygons e right triangles	1 Systematically collect, organize, and describe data a best method for collecting data b accurate organization of given data c describe data using ratio and proportion 2 Construct, read, and interpret displays of data a identify graphs that accurately represent given data b interpret displays of data c construct displays of data		4 Solve standard multi-step word problems 5 Solve nonstandard word problems

GRADE LEVEL 6	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
6	2 Compare fractions and decimals a compare two fractions using $<$, $>$, or $=$ b compare two decimals using $<$, $>$, or $=$ c order a set of fractions or decimals by magnitude 4 Compare a numerical sequence 6 Graph points representing positive rational numbers on a number line a select the fraction or decimal represented by a given point b select the point representing a given fraction or decimal	6 Add, subtract, multiply, and divide whole numbers 7 Solve number sentences a involving whole numbers and decimals b involving whole numbers and like fractions 8 Multiply fractions a whole numbers and fractions b fractions with denominators less than 10 9 Use operations in the correct order		1 Choose an appropriate unit of measure and the corresponding tool for a given situation a within the metric system b within the English system 6 Calculate areas and perimeters a of squares and rectangles 9 Convert units of measure within a system a metric system b English system	4 Compare and classify geometric shapes and solids a similar figures b congruent figures c identify a figure with a specified number of lines of symmetry d regular polygons e right triangles	1 Systematically collect, organize, and describe data a best method for collecting data b accurate organization of given data 2 Construct, read, and interpret displays of data a identify graphs that accurately represent given data b interpret displays of data c construct displays of data		1 Solve word problems involving money 4 Solve standard multi-step word problems 5 Solve nonstandard word problems

GRADE LEVEL 7	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
7	1 Communicate and interpret numbers a interpret calculator displays b express numbers in scientific notation with positive exponents c express large numbers in conventional notation 2 Compare positive rational numbers a compare fraction to fraction b compare decimal to fraction 5 Use numerical relationships to describe and simplify numerical situations 7 Apply number theory concepts a classify numbers as prime or composite b factors c multiples d multiple classifications	1 Recall fraction/decimal/percent equivalents 7 Solve linear equations (number sentences) a one-step b two-step 8 Compute the sum, difference, product, or quotient of fractions 9 Use operations in correct order a with + and/or - and + b with + and/or - and x 12 Compute solutions of problems involving percents a calculate percent of a number b calculate percent one number is of another c calculate the whole when a percent is given	1 Determine a reasonable estimate 2 Use estimation strategies and mental computation to determine if an answer is reasonable 5 Solve problems utilizing estimation a utilizing percents b utilizing fractions c utilizing decimals	1 Choose the appropriate unit of precision for a given measurement situation a in metric measurements b in standard measurements 2 Estimate measurement 6 Approximate and/or calculate areas and perimeters of irregularly shaped regions 10 Investigate the relationships among circumference, area, and diameter of a circle 11 Solve problems involving measurement	1 Recognize properties and relationships of lines and angles 2 Classify polygons a classify regular polygons with five or more sides b classify irregular polygons with five or more sides c classify quadrilaterals 3 Determine lines of symmetry in natural and geometric figures a in a natural figure b in a plane geometric figure 5 Identify the plane geometric figures which form the surfaces of three dimensional projects	1 Systematically collect, organize, and classify data a collect and organize statistical data b describe the most appropriate measure c determine mean d determine median e determine mode f determine range 2 Construct, read, and interpret displays of data a construct graphic data displays b identify correctly constructed bar and line graphs, pie charts, pictographs, and scattergrams c interpret bar and line graphs, pie charts, pictographs, and scattergrams 3 Formulate and solve problems that involve collecting and analyzing data	1 Create a problem to illustrate a given numerical sentence 2 Write a number sentence to illustrate a problem 3 Identify unnecessary or missing numerical data in a word problem	2 Solve problems involving percent in consumer situations a sales tax b discount c commission 4 Solve problems using ratio and proportion in consumer situations a involving pricing b involving recipe conversion c involving medication dosage d involving relative distances between locations

GRADE LEVEL 8	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
8	1 Communicate and interpret numbers a convert rational numbers to scientific notation b convert scientific notation to rational numbers 2 Compare rational numbers a compare fraction to fraction b compare decimal to fraction 5 Use mathematical relationships to describe and simplify mathematical expressions 7 Apply number theory a determine powers b determine square roots c determine cube roots	6 Compute the sum, difference, product, or quotient of integers 7 Solve linear equations a one-step b two-step 9 Evaluate algebraic expressions, given values for the variables	2 Use estimation strategies and mental computation to determine if an answer is reasonable 5 Solve problems utilizing estimation a utilizing percents b utilizing fractions c utilizing decimals	2 Estimate measurement 6 Calculate the perimeter or the area of a triangle, rectangle, or square 10 Calculate the circumference or the area of a circle 11 Solve problems involving measurement	1 Recognize properties and relationships of lines and angles a identify bisectors b identify radii c identify diagonals d identify diameters e identify interior angles f identify exterior angles 2 Classify polygons a classify triangles by sides/angles b classify quadrilaterals (e.g., parallelogram, rectangle, rhombus, trapezoid) 3 Recognize similar and congruent figures 5 Visualize, draw, and construct geometric figures	3 Formulate and solve problems that involve collecting and analyzing data 4 Calculate and interpret the probability of an event	1 Create a word problem to illustrate a given equation, or write an equation to illustrate a given problem 4 Follow a series of instructions in sequential order a in a flow chart b in a diagram c in a narrative	1 Solve problems involving money in consumer situations a involving simple interest b involving total cost of installment purchases c involving total cost of purchases including sales tax d involving discounts e involving sale prices 3 Solve problems involving area and perimeter in consumer situations 4 Solve problems using proportion in consumer situations a involving pricing b involving recipe conversion c involving medication dosage d involving relative distances between locations

GRADE LEVEL 9	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
9	5 Use mathematical relationships to simplify expressions a mathematical expressions b algebraic expressions 7 Apply number theory concepts	2 Compute using scientific notation 7 Solve linear equations a one/two steps with integral coefficients and integral or rational solutions	2 Judge reasonableness of solutions or estimates of solutions to problems 4 Determine the relative magnitude of fractional numbers 5 Solve problems utilizing estimation a consumer situations b practical situations	5 Compute the area and perimeter of irregularly shaped figures 11 Solve problems involving measurement a volume of cylinders b volume of rectangular solids	1 Recognize properties and relationships of lines and angles 4 Determine if a given point is on the graph of a given equation 5 Visualize, draw, and construct geometric figures 6 Solve problems using measures of inclination: (slope)	2 Calculate and interpret the probability of an event 3 Formulate and solve problems that involve collecting and analyzing statistical data a draw inferences b evaluate conclusions c solve problems involving mean, median, mode, and range 4 Judge the reliability of inferences drawn from statistical data	1 Translate word phrases and sentences into algebraic expressions and equations 2 Evaluate the validity of conclusions drawn from given premises and definitions 3 Identify impediments to solving a given problem a information to solve a problem b information missing to solve a problem c information unnecessary to solve a problem d information that needs to be converted to another form	1 Solve problems involving volume and area in consumer situations 2 Solve problems using proportion in consumer situations a involving pricing b involving food, recipes, and nutrition c involving medication dosage d involving relative distances between locations 3 Investigate problems involving personal finance 4 Compute gross pay using hourly, monthly, commission, piecework, and/or overtime rates

GRADE LEVEL 10	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
10	5 Use mathematical relationships to simplify expressions a mathematical expressions b algebraic expressions	7 Solve linear equations a with decimal coefficients b with fractional coefficients c with integral coefficients 10 Solve formulas for a given variable	1 Estimate solutions for various computational problems a using scientific notation b using whole numbers c using fractions d using decimals 2 Judge reasonableness of solutions 5 Solve problems utilizing estimation a on consumer situations b on practical situations	5 Solve problems requiring the application of the Pythagorean theorem a given diagrams and measurements of right triangles b given a situation involving a right triangle 11 Solve problems involving measurement	1 Recognize properties and relationships of lines and angles a parallel and perpendicular lines b complementary and supplementary angles c alternate interior and corresponding angles d calculate the third angle of a triangle 3 Graph equations a plot the graph of a linear equation b identify the graph of a linear equation c identify the slope of a line given its graph and equation d use the graph of a line to identify its equation 5 Visualize, draw, and construct geometric figures 6 Solve problems using the concepts of symmetry, similarity, and congruence a determine lines of symmetry b use the concept of congruence	2 Calculate and interpret the probability of an event 3 Identify limitations of an inference drawn from statistical data a limitations to an inference b additional information needed c demonstrable bias	1 State logical conclusions from given conditions 2 Evaluate the acceptability of a conclusion drawn through logical inference	2 Solve banking problems related to maintaining a checking account 4 Use appropriate information and tables to compute net pay, considering Social Security deductions, state and federal taxes, etc.

INTEGRATING VOCATIONAL COMPETENCIES AND MATH SKILLS

AUTO MECHANICS

Available from the
Instructional Materials Laboratory
University of Missouri-Columbia
10 London Hall
Columbia, Missouri 65211
314-882-2883
Catalog Number 65-7500-1

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FOREWORD

National interest and legislation support the need for identifying core competencies and key skills taught in industrial education classes. An understanding of the basic competencies involved will help identify academic subjects as they relate to specific occupations.

The following program area/math skills matrix can therefore be a valuable resource for program integration of academics, pre-testing and skills assessment, and special needs curriculum development. It identifies the math core competencies and key skills required for/taught in one of ten program areas at the Missouri secondary level. Matrices were developed for: Air Conditioning, Heating, and Refrigeration; Auto Collision Technology; Automotive Technology; Building Trades; Drafting; Electronics; Graphic Arts (Offset Lithography); Health Services Assistant; Machine Technology; and Welding.

The materials used to create the matrix include: the 1990 Core Competencies and Key Skills for Missouri Schools, grades two through ten; and Instructional Materials Laboratory vocational program competency profiles for the program areas involved.

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TO THE INSTRUCTOR: SUGGESTIONS FOR USE

The matrix that follows is divided into three columns. Reading in a row across all three of the columns will identify which math skills are involved in each vocational competency and tell whether the math skills are new to students or simply need reinforcement.

The first column identifies the vocational competencies involved in the program area. The numbers and competencies in this column refer to the Instructional Materials Laboratory competency profile for the program area.

The second column identifies which math skills are involved in the vocational competencies. The skills and numbers listed in this column refer to the 1990 Core Competencies and Key Skills for Missouri Schools, grades two through ten. (The list can also stand alone as a general list of math skills.) The column is blank for any vocational competency that the committee members decided did not require math skills.

Additional information about the math skills listed in the second column of the matrix may be found in the appendix following the matrix. The appendix is based on the math skills identified in the 1990 Core Competencies and Key Skills for Missouri Schools.

The last column tells whether the math skills will be new to students in the vocational classroom or whether they have been covered by math courses in the second through tenth grades. You may want to review and/or reinforce the math skills that students already have, and to make arrangements for them to learn the skills that are new to them.

As you use the matrix to help students learn or review math skills, keep in mind that different students learn in different ways. Efforts should be made to ensure that all students have an equal opportunity to understand and learn the material, regardless of race, color, national origin, gender, age, or disability.

Hold high expectations for all students, and provide the instruction necessary for students to meet those expectations. It is important that students achieve in math because research has shown a link between attitude toward mathematics and science, self-esteem levels, and career aspirations. According to a survey by the American Association of University Women: "Girls and boys who like mathematics and science have higher self-esteem, more ambitious career goals, and are more likely to hold onto their dreams."

As you help students achieve and develop this positive attitude toward mathematics, be aware that students of different genders give different reasons for their lack of interest in math. The AAUW survey states: "The gender differences in the intertwining of self-esteem and math/science interest is most evident in girls' and boys' reasons for their declining interest in math and science. While boys 'externalize' by seeing math and science as unimportant, girls 'internalize' by thinking themselves not smart enough."

AUTOMOTIVE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
B2. Estimate time and cost for job and order parts	Computation Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Measurement Convert units of measure within a system (6D-9)	R
	Graphing and Statistics Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving Identify impediments to solving a given problem (9G-3)	R
	Consumer Problems Solve problems involving money in consumer situations (8H-1)	R
B3. Obtain appropriate repair information from shop manuals	Computation Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Graphing and Statistics Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving Identify impediments to solving a given problem (9G-3)	R
B4. Practice clean and orderly work habits (vehicle, tools and work area)		
C1. Identify basic function and operation of vehicle mechanical components		

AUTOMOTIVE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
C2. Identify auto mechanics career opportunities and the duties of a technician		
D1. Check continuity in electrical circuits using test light and voltmeter, oscilloscope and wiring diagram	Computation - Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6) - Compute the sum, difference, product, or quotient of fractions (7B-8) - Solve formulas for a given variable (10B-10)	R R R
D2. Check for shorts, opens, and grounds	Computation - Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6) - Compute the sum, difference, product, or quotient of fractions (7B-8) Measurement - Solve problems involving measurement (7D-11) Problem Solving - Identify impediments to solving a given problem (9G-3)	R R R R

AUTOMOTIVE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
D3. Measure resistance in electrical circuits using an ohmmeter	Computation - Add and subtract whole numbers with up to four addends (4B-4) - Multiply and divide whole numbers (3-digit by 2-digit) (5B-5) Measurement - Solve problems involving measurement (7D-11)	R R R
D4. Measure volts with a voltmeter or oscilloscope	Computation - Compute solutions of problems involving percents (7B-12) Measurement - Solve problems involving measurement (7D-11)	R R
D5. Measure current with an ammeter	Computation - Add and subtract whole numbers with up to four addends (4B-4) - Multiply and divide whole numbers (3-digit by 2-digit) (5B-5) - Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6) Measurement - Solve problems involving measurement (7D-11)	R R R R
E1. Clean and inspect battery clamps, cables, and connectors		

AUTOMOTIVE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
E2. Perform battery condition tests	Computation	
	• Add and subtract whole numbers with up to four addends (4B-4)	R
	• Multiply and divide whole numbers (3-digit by 2-digit) (5B-5)	R
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Measurement	
	• Solve problems involving measurement (7D-11)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R
E3. Jump start a vehicle		

AUTOMOTIVE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
G1. Diagnose charging system and determine needed repairs	Computation • Compute solutions of problems involving percents (7B-12)	R
	Measurement • Solve problems involving measurement (7D-11)	R
	Problem Solving • Identify impediments to solving a given problem (9G-3)	R
G2. Remove, clean, and inspect alternator	Computation • Add and subtract whole numbers with up to four addends (4B-4)	R
	• Multiply and divide whole numbers (3-digit by 2-digit) (5B-5)	R
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Measurement • Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R

AUTOMOTIVE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
G3. Repair or replace alternator components	Computation	
	• Add and subtract whole numbers with up to four addends (4B-4)	R
	• Multiply and divide whole numbers (3-digit by 2-digit) (5B-5)	R
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R
G4. Repair or replace charging system components	Computation	
	• Add and subtract whole numbers with up to four addends (4B-4)	R
	• Multiply and divide whole numbers (3-digit by 2-digit) (5B-5)	R
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R

AUTOMOTIVE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
H1. Diagnose lighting system problems and determine needed repairs	Computation	
	• Add and subtract whole numbers with up to four addends (4B-4)	R
	• Multiply and divide whole numbers (3-digit by 2-digit) (5B-5)	R
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R
H2. Repair or replace lights, sockets, wires, and switches		

AUTOMOTIVE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
11. Diagnose and repair gauge and warning circuits	Computation	
	• Add and subtract whole numbers with up to four addends (4B-4)	R
	• Multiply and divide whole numbers (3-digit by 2-digit) (5B-5)	R
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R
	Problem Solving	
	• Identify impediments to solving a given problem (9G-3)	R

AUTOMOTIVE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
I2. Diagnose and repair electrical accessories (horn, wiper, motor)	Computation	
	• Add and subtract whole numbers with up to four addends (4B-4)	R
	• Multiply and divide whole numbers (3-digit by 2-digit) (5B-5)	R
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTOMOTIVE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
J1. Conduct engine performance test using engine analyzer and determine needed repairs	Computation Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Measurement Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Solve problems involving measurement (7D-11)	R
	Problem Solving Identify impediments to solving a given problem (9G-3)	R
J2. Inspect, repair, or replace primary ignition components	Computation Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Measurement Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Solve problems involving measurement (7D-11)	R
	Problem Solving Identify impediments to solving a given problem (9G-3)	R

AUTOMOTIVE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
J3. Inspect, repair, or replace secondary ignition components	Computation	R
	Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	
	Measurement	R
	- Choose the appropriate unit of precision for a given measurement situation (7D-1) - Solve problems involving measurement (7D-11)	R
J4. Adjust ignition system to manufacturer's specifications	Problem Solving	R
	Identify impediments to solving a given problem (9G-3)	
	Computation	R
	- Add and subtract whole numbers with up to four addends (4B-4) - Multiply and divide whole numbers (3-digit by 2-digit) (5B-5)	R
J5. Perform on-board computer system diagnosis	Geometry	R
	Recognize properties and relationships of lines and angles (7E-1)	
	Computation	R
	Add and subtract whole numbers with up to four addends (4B-4)	
	Measurement	R
	Solve problems involving measurement (7D-11)	
	Problem Solving	R
	Identify impediments to solving a given problem (9G-3)	

AUTOMOTIVE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
J6. Repair or replace computer system components		
K1. Diagnose fuel system problems and determine needed repairs	Measurement Solve problems involving measurement (7D-11)	R
	Problem Solving Identify impediments to solving a given problem (9G-3)	R
	Consumer Problems Solve problems using ratio and proportion in consumer situations (7H-4)	R
K2. Inspect, repair, or replace fuel supply component	Computation Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Solve problems involving measurement (7D-11)	R
	Problem Solving Identify impediments to solving a given problem (9G-3)	R

AUTOMOTIVE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
K3. Disassemble, clean, and inspect carburetors	Understanding Numbers Compare positive rational numbers (7A-2)	R
	Computation Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Solve problems involving measurement (7D-11)	R
	Graphing and Statistics Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving Identify impediments to solving a given problem (9G-3)	R

AUTOMOTIVE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
K4. Reassemble and adjust carburetors	Understanding Numbers Compare positive rational numbers (7A-2)	R
	Computation Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Solve problems involving measurement (7D-11)	R
	Graphing and Statistics Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving Identify impediments to solving a given problem (9G-3)	R

AUTOMOTIVE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
K5. Disassemble, clean, and inspect fuel injection components	Computation • Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement • Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R
	Problem Solving • Identify impediments to solving a given problem (9G-3)	R
	Consumer Problems • Solve problems using ratio and proportion in consumer situations (7H-4)	R
K6. Repair or replace fuel injection components		
K7. Adjust computer-controlled fuel systems (injection and carburetion)		
K8. Diagnose and repair exhaust system problems		

AUTOMOTIVE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
L1. Diagnose emission control systems and determine needed repairs	Problem Solving - State logical conclusions from given conditions (10G-1) - Evaluate the acceptability of a conclusion drawn through logical inference (10G-2) - Identify impediments to solving a given problem (9G-3) - Follow a series of instructions in sequential order (8G-4)	R R R R
L2. Clean, inspect/replace PCV system components		
L3. Clean, inspect/replace spark timing controllers		
L4. Clean, inspect/replace idle speed controllers		
L5. Clean, inspect/replace exhaust gas recirculation		
L6. Clean, inspect/replace air management system		
L7. Clean, inspect/replace inlet air temperature control		
L8. Clean, inspect/replace intake manifold heat controls		
L9. Clean, inspect/replace fuel vapor controls		

AUTOMOTIVE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
N4. Inspect and replace cam and related components	Computation - Add and subtract whole numbers with up to four addends (4B-4) - Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6) Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Solve problems involving measurement (7D-11)	R R R R
O1. Inspect and replace pans, covers, gaskets, and seals	Computation - Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6) Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1)	R R
O2. Disassemble, inspect, and clean short block assembly		
O3. Check and record short block measurements		
O4. Check and record component measurements		
O5. Clean and prep block and components for reassembly		

AUTOMOTIVE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
O6. Reassemble short block components using correct lubricants, gaskets, sealers, and torque specifications	Computation • Multiply and divide whole numbers (3-digit by 2-digit) (5B-5) • Solve formulas for a given variable (10B-10)	R R
P1. Complete engine assembly and pre-lube	Measurement • Choose the appropriate unit of precision for a given measurement situation (7D-1) • Convert units of measure within a system (6D-9) Problem Solving • Identify impediments to solving a given problem (9G-3)	R R R
P2. Start engine and set fuel and ignition system to manufacturer's specifications	Computation • Add and subtract whole numbers with up to four addends (4B-4) • Multiply and divide whole numbers (3-digit by 2-digit) (5B-5) Geometry • Recognize properties and relationships of lines and angles (7E-1)	R R R
Q1. Inspect and repair oil system and components		

AUTOMOTIVE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
Q2. Perform cooling system tests; determine needed repairs	Computation	
	• Add and subtract whole numbers with up to four addends (4B-4)	R
	• Multiply and divide whole numbers (3-digit by 2-digit) (5B-5)	R
	Measurement	
	• Solve problems involving measurement (7D-11)	R
	Problem Solving	
	• Identify impediments to solving a given problem (9G-3)	R
	Consumer Problems	
	• Solve problems using ratio and proportion in consumer situations (7H-4)	R
Q3. Inspect, replace, and adjust drive belts and hoses		

AUTOMOTIVE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
Q4. Replace cooling system components (thermostat, radiator, controllers)	Computation	
	• Add and subtract whole numbers with up to four addends (4B-4)	R
	• Multiply and divide whole numbers (3-digit by 2-digit) (5B-5)	R
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTOMOTIVE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
Q5. Inspect coolant, drain, flush, and refill cooling system with recommended coolant	Graphing and Statistics	R
	• Construct, read, and interpret displays of data (7F-2)	
	Problem Solving	R
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
Q6. Perform oil and lube service on normally aspirated and turbo-charged engines	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R
	Measurement	R
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	
	• Convert units of measure within a system (6D-9)	R
R1. Diagnose and determine needed repairs on steering systems	Problem Solving	R
	• Identify impediments to solving a given problem (9G-3)	
	Measurement	R
	• Convert units of measure within a system (6D-9)	
	• Solve problems involving measurement (7D-11)	R
	Problem Solving	R
	• Identify impediments to solving a given problem (9G-3)	

AUTOMOTIVE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
W1. Diagnose and determine needed repairs on drum brake systems	Computation Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Measurement Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
W2. Remove, clean, and inspect drum brake assemblies	Computation Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Measurement Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
W3. Repair, replace, and adjust drum brake components	Computation Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Measurement Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
X1. Diagnose and determine needed repairs on disc brake systems	Measurement Choose the appropriate unit of precision for a given measurement situation (7D-1)	R

AUTOMOTIVE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
X2. Remove, clean, and inspect disc brake components	Computation Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Measurement Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
X3. Repair, replace, and adjust disc brake components	Computation Compute solutions of problems involving percents (7B-12)	R
	Measurement Solve problems involving measurement (7D-11)	R
Y1. Diagnose and determine needed repairs on power-assist brakes		
Y2. Repair or replace power brake components		
Y3. Repair or replace hydra-boost components		
Y4. Check operation of anti-skid braking systems; adjust or repair according to manufacturer's recommendations		

AUTOMOTIVE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
Z1. Diagnose, performance test, and determine needed repair for clutch assembly	Computation	R
	• Compute solutions of problems involving percents (7B-12)	
	Problem Solving	R
	• State logical conclusions from given conditions (10G-1) • Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3) • Follow a series of instructions in sequential order (8G-4)	R
Z2. Replace and adjust clutch assembly	Computation	R
	• Add and subtract whole numbers with up to four addends (4B-4)	
	Measurement	R
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	
Aa1. Diagnose, performance test, and determine needed repair		
Aa2. Remove, disassemble, inspect, and clean manual transmission/transaxle and shift linkages		

AUTOMOTIVE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
Aa3. Reassemble manual transmission/transaxle assembly, check end-play and adjustments	Computation Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Measurement Solve problems involving measurement (7D-11)	R
	Problem Solving Identify impediments to solving a given problem (9G-3)	R
Bb1. Diagnose and determine needed repairs		
Bb2. Inspect, service and replace front axle shafts	Measurement Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Solve problems involving measurement (7D-11)	R
Bb3. Inspect, service and replace drive shafts	Measurement Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Solve problems involving measurement (7D-11)	R
Cc1. Diagnose and determine needed repairs	Measurement Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Solve problems involving measurement (7D-11)	R
Cc2. Disassemble, clean and inspect differential assembly		

AUTOMOTIVE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
Cc3. Reassemble and adjust differential assembly	Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Solve problems involving measurement (7D-11)	R R
Dd1. Diagnose and determine needed repairs on transfer case	Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Solve problems involving measurement (7D-11)	R R
Dd2. Disassemble, inspect and clean transfer case	Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Solve problems involving measurement (7D-11)	R R
Dd3. Reassemble and adjust transfer case	Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Solve problems involving measurement (7D-11)	R R
Dd4. Diagnose and determine needed repairs on hub assemblies	Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Solve problems involving measurement (7D-11)	R R

AUTOMOTIVE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
Dd5. Disassemble, clean, and inspect hub assemblies	Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Solve problems involving measurement (7D-11)	R R
Dd6. Reassemble and adjust hub assemblies	Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Solve problems involving measurement (7D-11)	R R
Ee1. Diagnose, performance test transmission/transaxle, and determine needed repair	Computation - Add and subtract whole numbers with up to four addends (4B-4) Measurement - Solve problems involving measurement (7D-11)	R R
Ee2. Service transmission and cooler and perform adjustments	Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Convert units of measure within a system (6D-9) - Solve problems involving measurement (7D-11)	R R R
Ee3. Inspect, adjust, and replace sensors, cables, and actuators	Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Convert units of measure within a system (6D-9) - Solve problems involving measurement (7D-11)	R R R

AUTOMOTIVE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
Ee4. Inspect and replace external bushings, seals and gaskets		
Ee5. Inspect, replace and align power train mounts		
Ff1. Remove, disassemble and clean transmission/transaxle assembly	Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Solve problems involving measurement (7D-11)	R R
Ff2. Clean and inspect oil pump and converter	Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Solve problems involving measurement (7D-11)	R R
Ff3. Clean and inspect gear train, shafts, bushings, and case	Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Solve problems involving measurement (7D-11)	R R
Ff4. Clean and inspect friction and reaction units	Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Solve problems involving measurement (7D-11)	R R

AUTOMOTIVE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
Ff5. Reassemble automatic transmission/transaxle assembly, check end-play and adjustments, and install assembly	Computation Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Measurement Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Solve problems involving measurement (7D-11)	R
	Problem Solving Identify impediments to solving a given problem (9G-3)	R
Gg1. Diagnose and performance test A/C systems for problems and determine needed repairs	Measurement Solve problems involving measurement (7D-11)	R
	Graphing and Statistics Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving State logical conclusions from given conditions (10G-1)	R
	Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	Identify impediments to solving a given problem (9G-3)	R
	Follow a series of instructions in sequential order (8G-4)	R

AUTOMOTIVE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
Gg2. Clean, inspect and repair A/C system components	Graphing and Statistics Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving State logical conclusions from given conditions (10G-1)	R
	Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	Identify impediments to solving a given problem (9G-3)	R
	Follow a series of instructions in sequential order (8G-4)	R
	Consumer Problems Solve problems involving money in consumer situations (8H-1)	R

AUTOMOTIVE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
Gg3. Evacuate and charge A/C system and performance test	Measurement	
	• Convert units of measure within a system (6D-9)	R
	• Solve problems involving measurement (7D-11)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	• Formulate and solve problems that involve collecting and analyzing data (7F-3)	R
	Problem Solving	
	• State logical conclusions from given conditions (10G-1)	R
	• Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

AUTOMOTIVE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
Gg4. Diagnose and repair automatic and electrical temperature control units	Measurement Solve problems involving measurement (7D-11)	R
	Problem Solving State logical conclusions from given conditions (10G-1)	R
	Evaluate the acceptability of a conclusion drawn through logical inference (10G-2)	R
	Identify impediments to solving a given problem (9G-3)	R
	Follow a series of instructions in sequential order (8G-4)	R
Hh1. Diagnose and repair heating system problems and determine needed repairs	Consumer Problems Solve problems using ratio and proportion in consumer situations (7H-4)	R
	Measurement Solve problems involving measurement (7D-11)	R
	Problem Solving Identify impediments to solving a given problem (9G-3)	R
	Consumer Problems Solve problems using ratio and proportion in consumer situations (7H-4)	R

AUTOMOTIVE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
Hh2. Inspect and replace heating system components	Measurement Solve problems involving measurement (7D-11)	R
	Problem Solving Identify impediments to solving a given problem (9G-3)	R
	Consumer Problems Solve problems using ratio and proportion in consumer situations (7H-4)	R

APPENDIX:
Additional Math Skills Information

Based on
1990 Core Competencies And Key Skills
For Missouri Schools

Mathematics
Grade 2-10

GRADE LEVEL 2	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
2	2 Compare whole numbers 3 Identify place value a the digit in the ones', tens', or hundreds' place b the place value of a given digit by name c the value of a digit in the ones', tens', or hundreds' place 4 Complete and create patterns a number b geometric c graphic 6 Identify fractional parts	2 Add whole numbers 3 Subtract whole numbers 7 Explore the use of open sentences to describe mathematical relationships a involving addition b involving subtraction c which represent given computational situations		3 Tell and record time	1 Describe, model, draw, and classify shapes a rectangles and squares b circles c triangles	2 Construct, read, and interpret displays of data a bar graphs b pictographs c other displays of data		2 Solve word problems involving addition 3 Solve word problems involving subtraction

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GRADE LEVEL 3	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
3	2 Compare numbers a compare two numbers using < or > b order a set of numbers by magnitude 3 Identify place value a the digit in the ones', tens', hundreds', or thousands' place b the place value of a given digit by name c the value of a digit in the ones', tens', hundreds', or thousands' place 6 Identify fractional parts	4 Add and subtract whole numbers with regrouping 5 Multiply whole numbers 7 Explore the use of open sentences to describe mathematical relationships a involving addition b involving subtraction c involving multiplication and division d identify open sentences that represent given computational situations		3 Tell and record time a relate various recording conventions to each other 5 Measure length, weight (mass), volume, and capacity using nonstandard and standard units a nearest inch b nearest centimeter c nearest pound or kilogram d nearest cup, pint, quart, gallon, and liter	2 Identify cones, cylinders, spheres, pyramids, and cubes	2 Construct, read, and interpret displays of data a read bar graphs and pictographs b contrast displays of data c interpret displays of data 3 Locate points on a grid		2 Solve word problems involving addition and subtraction of money 4 Solve word problems using addition, subtraction, and multiplication

GRADE LEVEL 4	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
4	3 Identify place value a the digit in the ones', tens', hundreds', thousands', or ten thousands' place b the place value of a given digit by name through ten thousands c the value of a specified digit(s) through the ten thousands' place 6 Graph points representing fractions on a number line a select the fraction represented by a given point on a number line b select the point on a number line representing a given fraction	4 Add and subtract whole numbers with up to four addends 5 Multiply whole numbers (3-digit by 1-digit) 7 Use open sentences to express mathematical relationships a identify the open sentence which represents a computational situation involving addition and/or subtraction, and multiplication and/or division b identify the computational situation which represents an open sentence involving addition and/or subtraction and multiplication and/or division	3 Recognize a situation in which an estimate or an exact answer is appropriate	2 Estimate measurements including area and perimeter of regular and irregular regions 5 Measure lengths a to the nearest half inch b to the nearest centimeter	2 Explore properties of right angles	2 Construct, read, and interpret displays of data a select bar graphs and pictographs b contrast displays of data		2 Solve problems involving money management a with computational algorithms b which may require nonstandard strategies 4 Solve standard multi-step word problems, using one or more than one operation 5 Solve nonstandard word problems

GRADE LEVEL 5	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
5	2 Compare unit fractions a compare two fractions using $<$ or $>$ b order a set of fractions by magnitude 3 Compare decimals a compare two decimals using $<$, $>$, or $=$ b order a set of decimals by magnitude 7 Apply number theory concepts a factors b multiples	5 Multiply and divide whole numbers (3-digit by 2-digit) 7 Solve number sentences a involving addition and subtraction with whole numbers and/or decimals b involving multiplication and division with whole numbers with 1-digit multipliers and divisors 8 Add and subtract like fractions	2 Use estimation strategies and mental computation to determine whether an answer is reasonable	2 Estimate measurements a linear measure b area, mass, and volume measures 6 Measure area and perimeter of regular and irregular regions using nonstandard and standard units 9 Convert units of measure within a system a metric system b English system	1 Identify properties of lines a intersecting, parallel, and perpendicular lines b vertical, horizontal, and diagonal (oblique) lines 4 Compare and classify geometric shapes and solids a similar figures b congruent figures c identify a figure with a specified number of lines of symmetry d regular polygons e right triangles	1 Systematically collect, organize, and describe data a best method for collecting data b accurate organization of given data c describe data using ratio and proportion 2 Construct, read, and interpret displays of data a identify graphs that accurately represent given data b interpret displays of data c construct displays of data		4 Solve standard multi-step word problems 5 Solve nonstandard word problems

GRADE LEVEL 6	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
6	2 Compare fractions and decimals a compare two fractions using $<$, $>$, or $=$ b compare two decimals using $<$, $>$, or $=$ c order a set of fractions or decimals by magnitude 4 Compare a numerical sequence 6 Graph points representing positive rational numbers on a number line a select the fraction or decimal represented by a given point b select the point representing a given fraction or decimal	6 Add, subtract, multiply, and divide whole numbers 7 Solve number sentences a involving whole numbers and decimals b involving whole numbers and like fractions 8 Multiply fractions a whole numbers and fractions b fractions with denominators less than 10 9 Use operations in the correct order		1 Choose an appropriate unit of measure and the corresponding tool for a given situation a within the metric system b within the English system 6 Calculate areas and perimeters a of squares and rectangles 9 Convert units of measure within a system a metric system b English system	4 Compare and classify geometric shapes and solids a similar figures b congruent figures c identify a figure with a specified number of lines of symmetry d regular polygons e right triangles	1 Systematically collect, organize, and describe data a best method for collecting data b accurate organization of given data 2 Construct, read, and interpret displays of data a identify graphs that accurately represent given data b interpret displays of data c construct displays of data		1 Solve word problems involving money 4 Solve standard multi-step word problems 5 Solve nonstandard word problems

GRADE LEVEL 7	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
7	1 Communicate and interpret numbers a interpret calculator displays b express numbers in scientific notation with positive exponents c express large numbers in conventional notation 2 Compare positive rational numbers a compare fraction to fraction b compare decimal to fraction 5 Use numerical relationships to describe and simplify numerical situations 7 Apply number theory concepts a classify numbers as prime or composite b factors c multiples d multiple classifications	1 Recall fraction/decimal/percent equivalents 7 Solve linear equations (number sentences) a one-step b two-step 8 Compute the sum, difference, product, or quotient of fractions 9 Use operations in correct order a with + and/or - and × b with + and/or - and ÷ 12 Compute solutions of problems involving percents a calculate percent of a number b calculate percent one number is of another c calculate the whole when a percent is given	1 Determine a reasonable estimate 2 Use estimation strategies and mental computation to determine if an answer is reasonable 5 Solve problems utilizing estimation a utilizing percents b utilizing fractions c utilizing decimals	1 Choose the appropriate unit of precision for a given measurement situation a in metric measurements b in standard measurements 2 Estimate measurement 6 Approximate and/or calculate areas and perimeters of irregularly shaped regions 10 Investigate the relationships among circumference, area, and diameter of a circle 11 Solve problems involving measurement	1 Recognize properties and relationships of lines and angles 2 Classify polygons a classify regular polygons with five or more sides b classify irregular polygons with five or more sides c classify quadrilaterals 3 Determine lines of symmetry in natural and geometric figures a in a natural figure b in a plane geometric figure 5 Identify the plane geometric figures which form the surfaces of three dimensional projects	1 Systematically collect, organize, and classify data a collect and organize statistical data b describe the most appropriate measure c determine mean d determine median e determine mode f determine range 2 Construct, read, and interpret displays of data a construct graphic data displays b identify correctly constructed bar and line graphs, pie charts, pictographs, and scattergrams c interpret bar and line graphs, pie charts, pictographs, and scattergrams 3 Formulate and solve problems that involve collecting and analyzing data	1 Create a problem to illustrate a given numerical sentence 2 Write a number sentence to illustrate a problem 3 Identify unnecessary or missing numerical data in a word problem	2 Solve problems involving percent in consumer situations a sales tax b discount c commission 4 Solve problems using ratio and proportion in consumer situations a involving pricing b involving recipe conversion c involving medication dosage d involving relative distances between locations

GRADE LEVEL 8	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
8	1 Communicate and interpret numbers a convert rational numbers to scientific notation b convert scientific notation to rational numbers 2 Compare rational numbers a compare fraction to fraction b compare decimal to fraction 5 Use mathematical relationships to describe and simplify mathematical expressions 7 Apply number theory a determine powers b determine square roots c determine cube roots	6 Compute the sum, difference, product, or quotient of integers 7 Solve linear equations a one-step b two-step 9 Evaluate algebraic expressions, given values for the variables	2 Use estimation strategies and mental computation to determine if an answer is reasonable 5 Solve problems utilizing estimation a utilizing percents b utilizing fractions c utilizing decimals	2 Estimate measurement 6 Calculate the perimeter or the area of a triangle, rectangle, or square 10 Calculate the circumference or the area of a circle 11 Solve problems involving measurement	1 Recognize properties and relationships of lines and angles a identify bisectors b identify radii c identify diagonals d identify diameters e identify interior angles f identify exterior angles 2 Classify polygons a classify triangles by sides/angles b classify quadrilaterals (e.g., parallelogram, rectangle, rhombus, trapezoid) 3 Recognize similar and congruent figures 5 Visualize, draw, and construct geometric figures	3 Formulate and solve problems that involve collecting and analyzing data 4 Calculate and interpret the probability of an event	1 Create a word problem to illustrate a given equation, or write an equation to illustrate a given problem 4 Follow a series of instructions in sequential order a in a flow chart b in a diagram c in a narrative	1 Solve problems involving money in consumer situations a involving simple interest b involving total cost of installment purchases c involving total cost of purchases including sales tax d involving discounts e involving sale prices 3 Solve problems involving area and perimeter in consumer situations 4 Solve problems using proportion in consumer situations a involving pricing b involving recipe conversion c involving medication dosage d involving relative distances between locations

GRADE LEVEL 9	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
9	5 Use mathematical relationships to simplify expressions a mathematical expressions b algebraic expressions 7 Apply number theory concepts	2 Compute using scientific notation 7 Solve linear equations a one/two steps with integral coefficients and integral or rational solutions	2 Judge reasonableness of solutions or estimates of solutions to problems 4 Determine the relative magnitude of fractional numbers 5 Solve problems utilizing estimation a consumer situations b practical situations	5 Compute the area and perimeter of irregularly shaped figures 11 Solve problems involving measurement a volume of cylinders b volume of rectangular solids	1 Recognize properties and relationships of lines and angles 4 Determine if a given point is on the graph of a given equation 5 Visualize, draw, and construct geometric figures 6 Solve problems using measures of inclination: (slope)	2 Calculate and interpret the probability of an event 3 Formulate and solve problems that involve collecting and analyzing statistical data a draw inferences b evaluate conclusions c solve problems involving mean, median, mode, and range 4 Judge the reliability of inferences drawn from statistical data	1 Translate word phrases and sentences into algebraic expressions and equations 2 Evaluate the validity of conclusions drawn from given premises and definitions 3 Identify impediments to solving a given problem a information to solve a problem b information missing to solve a problem c information unnecessary to solve a problem d information that needs to be converted to another form	1 Solve problems involving volume and area in consumer situations 2 Solve problems using proportion in consumer situations a involving pricing b involving food, recipes, and nutrition c involving medication dosage d involving relative distances between locations 3 Investigate problems involving personal finance 4 Compute gross pay using hourly, monthly, commission, piecework, and/or overtime rates

GRADE LEVEL 10	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
10	5 Use mathematical relationships to simplify expressions a mathematical expressions b algebraic expressions	7 Solve linear equations a with decimal coefficients b with fractional coefficients c with integral coefficients 10 Solve formulas for a given variable	1 Estimate solutions for various computational problems a using scientific notation b using whole numbers c using fractions d using decimals 2 Judge reasonableness of solutions 5 Solve problems utilizing estimation a on consumer situations b on practical situations	5 Solve problems requiring the application of the Pythagorean theorem a given diagrams and measurements of right triangles b given a situation involving a right triangle 11 Solve problems involving measurement	1 Recognize properties and relationships of lines and angles a parallel and perpendicular lines b complementary and supplementary angles c alternate interior and corresponding angles d calculate the third angle of a triangle 3 Graph equations a plot the graph of a linear equation b identify the graph of a linear equation c identify the slope of a line given its graph and equation d use the graph of a line to identify its equation 5 Visualize, draw, and construct geometric figures 6 Solve problems using the concepts of symmetry, similarity, and congruence a determine lines of symmetry b use the concept of congruence	2 Calculate and interpret the probability of an event 3 Identify limitations of an inference drawn from statistical data a limitations to an inference b additional information needed c demonstrable bias	1 State logical conclusions from given conditions 2 Evaluate the acceptability of a conclusion drawn through logical inference	2 Solve banking problems related to maintaining a checking account 4 Use appropriate information and tables to compute net pay, considering Social Security deductions, state and federal taxes, etc.

INTEGRATING VOCATIONAL COMPETENCIES AND MATH SKILLS

BUILDING TRADES

Available from the
Instructional Materials Laboratory
University of Missouri-Columbia
10 London Hall
Columbia, Missouri 65211
314-882-2883
Catalog Number 65-7500-I

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FOREWORD

National interest and legislation support the need for identifying core competencies and key skills taught in industrial education classes. An understanding of the basic competencies involved will help identify academic subjects as they relate to specific occupations.

The following program area/math skills matrix can therefore be a valuable resource for program integration of academics, pre-testing and skills assessment, and special needs curriculum development. It identifies the math core competencies and key skills required for/taught in one of ten program areas at the Missouri secondary level. Matrices were developed for: Air Conditioning, Heating, and Refrigeration; Auto Collision Technology; Automotive Technology; Building Trades; Drafting; Electronics; Graphic Arts (Offset Lithography); Health Services Assistant; Machine Technology; and Welding.

The materials used to create the matrix include: the 1990 Core Competencies and Key Skills for Missouri Schools, grades two through ten; and Instructional Materials Laboratory vocational program competency profiles for the program areas involved.

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TO THE INSTRUCTOR: SUGGESTIONS FOR USE

The matrix that follows is divided into three columns. Reading in a row across all three of the columns will identify which math skills are involved in each vocational competency and tell whether the math skills are new to students or simply need reinforcement.

The first column identifies the vocational competencies involved in the program area. The numbers and competencies in this column refer to the Instructional Materials Laboratory competency profile for the program area.

The second column identifies which math skills are involved in the vocational competencies. The skills and numbers listed in this column refer to the 1990 Core Competencies and Key Skills for Missouri Schools, grades two through ten. (The list can also stand alone as a general list of math skills.) The column is blank for any vocational competency that the committee members decided did not require math skills.

Additional information about the math skills listed in the second column of the matrix may be found in the appendix following the matrix. The appendix is based on the math skills identified in the 1990 Core Competencies and Key Skills for Missouri Schools.

The last column tells whether the math skills will be new to students in the vocational classroom or whether they have been covered by math courses in the second through tenth grades. You may want to review and/or reinforce the math skills that students already have, and to make arrangements for them to learn the skills that are new to them.

As you use the matrix to help students learn or review math skills, keep in mind that different students learn in different ways. Efforts should be made to ensure that all students have an equal opportunity to understand and learn the material, regardless of race, color, national origin, gender, age, or disability.

Hold high expectations for all students, and provide the instruction necessary for students to meet those expectations. It is important that students achieve in math because research has shown a link between attitude toward mathematics and science, self-esteem levels, and career aspirations. According to a survey by the American Association of University Women: "Girls and boys who like mathematics and science have higher self-esteem, more ambitious career goals, and are more likely to hold onto their dreams."

As you help students achieve and develop this positive attitude toward mathematics, be aware that students of different genders give different reasons for their lack of interest in math. The AAUW survey states: "The gender differences in the intertwining of self-esteem and math/science interest is most evident in girls' and boys' reasons for their declining interest in math and science. While boys 'externalize' by seeing math and science as unimportant, girls 'internalize' by thinking themselves not smart enough."

BUILDING TRADES		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
A10. Construct scaffolding		
A11. Identify methods and materials for thermal insulation		
A12. Identify types and qualities of exterior protective coatings		
A13. Identify purposes of building codes, zoning laws and building permits		
B1. Read and interpret working drawings	Consumer Problems Solve problems using ratio and proportion in consumer situations (7H-4)	R
B2. Interpret blueprint symbols		
B3. Identify the steps of the building process		

BUILDING TRADES		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
B4. Estimate labor costs	Computation	
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	• Compute the sum, difference, product, or quotient of integers (8B-6)	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Measurement	
	• Compute the area and perimeter of irregularly shaped figures (9D-5)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	Consumer Problems	
	• Solve problems involving money in consumer situations (8H-1)	R
	• Solve problems involving area and perimeter in consumer situations (8H-3)	R
B5. Identify grades of lumber and plywood		

BUILDING TRADES		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
B6. Organize building materials	Computation	
	• Recall fraction/decimal/percent equivalents (7B-1)	R
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	• Solve linear equations (number sentences) (7B-7)	R
	• Solve linear equations (one step and two step) (8B-7)	R
	• Solve linear equations (one/two steps with integral coefficients and integral or rational solutions) (9B-7)	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	• Solve formulas for a given variable (10B-10)	R
	• Compute solutions of problems involving percents (7B-12)	R

BUILDING TRADES		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
B6. Organize building materials (cont'd.)	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Compute the area and perimeter of irregularly shaped figures (9D-5)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	• Calculate the perimeter or the area of a triangle, rectangle, or square (8D-6)	R
	• Convert units of measure within a system (6D-9)	R
	• Solve problems involving measurement (volume) (9D-11)	
	Consumer Problems	
	• Solve problems involving money in consumer situations (8H-1)	R
	• Solve problems involving area and perimeter in consumer situations (8H-3)	R
C1. Use builder's level		
C2. Establish elevation reference points from bench mark		
C3. Layout building	Measurement	
	• Solve problems requiring the application of the Pythagorean theorem (10D-5)	R

BUILDING TRADES		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
D1. Construct footing forms	Computation	R
	- Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6) - Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement	R
	- Convert units of measure within a system (6D-9) - Solve problems involving measurement (volume) (9D-11)	R
D2. Install keyway for footing and foundation	Consumer Problems	R
	Solve problems involving volume and area in consumer situations (9H-1)	
	Computation	R
	- Solve linear equations (number sentences) (7B-7) - Solve linear equations (one step and two step) (8B-7) - Solve linear equations (one/two steps with integral coefficients and integral or rational solutions) (9B-7)	R

BUILDING TRADES		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
D3. Erect plywood panel wall forms	Computation Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Estimation Solve problems utilizing estimation (9C-5)	R
	Measurement Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Measurement Convert units of measure within a system (6D-9)	R
D4. Erect manufactured wall forms	Measurement Choose the appropriate unit of precision for a given measurement situation (7D-1)	R

BUILDING TRADES		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
D5. Construct concrete stair forms	Computation	R
	Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement	R
	Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Convert units of measure within a system (6D-9)	R
D6. Construct box for specified (special) openings	Solve problems involving measurement (volume) (9D-11)	R
	Geometry	R
	Solve problems using measures of inclination (9E-6)	R
	Consumer Problems	R
	Solve problems involving volume and area in consumer situations (9H-1)	R
	Computation	R
	Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement	R
	Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Convert units of measure within a system (6D-9)	R

BUILDING TRADES		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
D7. Strip forms		
D8. Layout and install anchor bolts in concrete	Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Convert units of measure within a system (6D-9) - Solve problems involving measurement (volume) (9D-11)	R R R
D9. Install bulkhead	Computation - Compute the sum, difference, product, or quotient of fractions (7B-8) Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Convert units of measure within a system (6D-9) - Solve problems involving measurement (volume) (9D-11)	R R R R
D10. Install expansion and contraction joint	Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Convert units of measure within a system (6D-9) - Solve problems involving measurement (volume) (9D-11)	R R R

BUILDING TRADES		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
E1. Install termite shield	Computation	
	• Recall fraction/decimal/percent equivalents (7B-1)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Compute the area and perimeter of irregularly shaped figures (9D-5)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	• Calculate the perimeter or the area of a triangle, rectangle, or square (8D-6)	R
	• Convert units of measure within a system (6D-9)	R
	Consumer Problems	
	• Solve problems involving area and perimeter in consumer situations (8H-3)	R

BUILDING TRADES		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
E4. Install sill plate and sealer	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Compute the area and perimeter of irregularly shaped figures (9D-5)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	• Convert units of measure within a system (6D-9)	R
	Consumer Problems	
	• Solve problems involving area and perimeter in consumer situations (8H-3)	R

BUILDING TRADES		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
E5. Construct sill box	Computation • Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement • Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Compute the area and perimeter of irregularly shaped figures (9D-5)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	• Convert units of measure within a system (6D-9)	R
	Consumer Problems • Solve problems involving area and perimeter in consumer situations (8H-3)	R

BUILDING TRADES		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
E6. Install floor joists	Computation	
	• Recall fraction/decimal/percent equivalents (7B-1)	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Compute the area and perimeter of irregularly shaped figures (9D-5)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	• Calculate the perimeter or the area of a triangle, rectangle, or square (8D-6)	R
	• Convert units of measure within a system (6D-9)	R
	Consumer Problems	
	• Solve problems involving area and perimeter in consumer situations (8H-3)	R

BUILDING TRADES		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
E7. Frame floor opening	Computation • Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Estimation • Solve problems utilizing estimation (9C-5)	R
	Measurement • Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Compute the area and perimeter of irregularly shaped figures (9D-5)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	• Convert units of measure within a system (6D-9)	R
	• Solve problems involving measurement (volume) (9D-11)	R
	Consumer Problems • Solve problems involving area and perimeter in consumer situations (8H-3)	R

BUILDING TRADES		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
E8. Install subfloor	Computation	
	• Recall fraction/decimal/percent equivalents (7B-1)	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Compute the area and perimeter of irregularly shaped figures (9D-5)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	• Calculate the perimeter or the area of a triangle, rectangle, or square (8D-6)	R
	• Convert units of measure within a system (6D-9)	R
	Consumer Problems	
	• Solve problems involving volume and area in consumer situations (9H-1)	R
	• Solve problems involving area and perimeter in consumer situations (8H-3)	R

BUILDING TRADES		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
E9. Install cross-bridging	Computation	
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Compute the area and perimeter of irregularly shaped figures (9D-5)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	• Convert units of measure within a system (6D-9)	R
	Consumer Problems	
	• Solve problems involving area and perimeter in consumer situations (8H-3)	R

BUILDING TRADES		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
F1. Construct corner post	Computation • Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement • Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Compute the area and perimeter of irregularly shaped figures (9D-5)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	• Convert units of measure within a system (6D-9)	R
	Consumer Problems • Solve problems involving area and perimeter in consumer situations (8H-3)	R

BUILDING TRADES		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
F2. Construct partition studs	Computation • Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement • Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Compute the area and perimeter of irregularly shaped figures (9D-5)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	Consumer Problems • Solve problems involving area and perimeter in consumer situations (8H-3)	R

BUILDING TRADES		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
F3. Frame openings	Computation	
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Estimation	
	• Solve problems utilizing estimation (9C-5)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Compute the area and perimeter of irregularly shaped figures (9D-5)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	• Convert units of measure within a system (6D-9)	R
	• Solve problems involving measurement (volume) (9D-11)	R
	Consumer Problems	
	• Solve problems involving volume and area in consumer situations (9H-1)	R
	• Solve problems involving area and perimeter in consumer situations (8H-3)	R

BUILDING TRADES		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
F4. Install diagonal bracing (wind brace)	Measurement	R
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	
	• Compute the area and perimeter of irregularly shaped figures (9D-5)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	Geometry	
	• Solve problems using measures of inclination (9E-6)	R
	Consumer Problems	
	• Solve problems involving area and perimeter in consumer situations (8H-3)	R
F5. Align and brace wall	Measurement	R
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	
	• Compute the area and perimeter of irregularly shaped figures (9D-5)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	Consumer Problems	
	• Solve problems involving area and perimeter in consumer situations (8H-3)	R

BUILDING TRADES		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
F6. Install backing for hanging fixture and cabinet	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Compute the area and perimeter of irregularly shaped figures (9D-5)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	• Solve problems involving measurement (volume) (9D-11)	R
	Consumer Problems	
	• Solve problems involving area and perimeter in consumer situations (8H-3)	R

BUILDING TRADES		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
F7. Install exterior wall sheathing	Computation • Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement • Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Compute the area and perimeter of irregularly shaped figures (9D-5)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	• Solve problems involving measurement (volume) (9D-11)	R
	Consumer Problems • Solve problems involving area and perimeter in consumer situations (8H-3)	R

BUILDING TRADES		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
F8. Install metal studs	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Compute the area and perimeter of irregularly shaped figures (9D-5)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	Consumer Problems	
	• Solve problems involving area and perimeter in consumer situations (8H-3)	R

BUILDING TRADES		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
G1. Install ceiling joists	Computation • Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement • Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Compute the area and perimeter of irregularly shaped figures (9D-5)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	• Convert units of measure within a system (6D-9)	R
	Consumer Problems • Solve problems involving area and perimeter in consumer situations (8H-3)	R

BUILDING TRADES		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
G2. Install ridgeboard	Computation • Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement • Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Compute the area and perimeter of irregularly shaped figures (9D-5)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	• Convert units of measure within a system (6D-9)	R
	Consumer Problems • Solve problems involving area and perimeter in consumer situations (8H-3)	R

BUILDING TRADES		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
G3. Layout, cut and install common rafters	Understanding Numbers	
	• Apply number theory concepts (9A-7)	R
	Computation	
	• Recall fraction/decimal/percent equivalents (7B-1)	R
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Compute the area and perimeter of irregularly shaped figures (9D-5)	R
	• Solve problems requiring the application of the Pythagorean theorem (10D-5)	R
	• Convert units of measure within a system (6D-9)	R
	Geometry	
	• Solve problems using measures of inclination (9E-6)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Consumer Problems	
	• Solve problems involving area and perimeter in consumer situations (8H-3)	R

BUILDING TRADES		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
G4. Install roof trusses	Measurement	
	Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Solve problems requiring the application of the Pythagorean theorem (10D-5)	R
	Geometry	
	Solve problems using measures of inclination (9E-6)	R
	Solve problems using the concepts of symmetry, similarity, and congruence (10E-6)	R

BUILDING TRADES		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
G5. Layout, cut and install hip rafters	Understanding Numbers • Apply number theory concepts (9A-7)	R
	Computation • Recall fraction/decimal/percent equivalents (7B-1)	R
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Measurement • Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems requiring the application of the Pythagorean theorem (10D-5)	R
	• Convert units of measure within a system (6D-9)	R
	Geometry • Solve problems using measures of inclination (9E-6)	R
	• Solve problems using the concepts of symmetry, similarity, and congruence (10E-6)	R
	Graphing and Statistics • Construct, read, and interpret displays of data (7F-2)	R

BUILDING TRADES		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
G6. Layout, cut and install valley rafters	Understanding Numbers • Apply number theory concepts (9A-7)	R
	Computation • Recall . fraction/decimal/percent equivalents (7B-1)	R
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Measurement • Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems requiring the application of the Pythagorean theorem (10D-5)	R
	• Convert units of measure within a system (6D-9)	R
	Geometry • Solve problems using measures of inclination (9E-6) • Solve problems using the concepts of symmetry, similarity, and congruence (10E-6)	R
	Graphing and Statistics • Construct, read, and interpret displays of data (7F-2)	R

BUILDING TRADES		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
G7. Layout, cut and install tail rafters	Understanding Numbers	
	• Apply number theory concepts (9A-7)	R
	Computation	
	• Recall fraction/decimal/percent equivalents (7B-1)	R
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems requiring the application of the Pythagorean theorem (10D-5)	R
	• Convert units of measure within a system (6D-9)	R
	Geometry	
	• Solve problems using measures of inclination (9E-6)	R
	• Solve problems using the concepts of symmetry, similarity, and congruence (10E-6)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R

BUILDING TRADES		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
G8. Layout, cut and install cripple jack rafters	Understanding Numbers	R
	• Apply number theory concepts (9A-7)	
	Computation	R
	• Recall fraction/decimal/percent equivalents (7B-1)	
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems requiring the application of the Pythagorean theorem (10D-5)	
	• Convert units of measure within a system (6D-9)	R
	Geometry	
	• Solve problems using measures of inclination (9E-6)	R
	• Solve problems using the concepts of symmetry, similarity, and congruence (10E-6)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R

BUILDING TRADES		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
G9. Layout, cut and install hip jack rafters	Understanding Numbers	R
	• Apply number theory concepts (9A-7)	
	Computation	R
	• Recall fraction/decimal/percent equivalents (7B-1)	
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems requiring the application of the Pythagorean theorem (10D-5)	
	• Convert units of measure within a system (6D-9)	R
	Geometry	
	• Solve problems using measures of inclination (9E-6)	R
	• Solve problems using the concepts of symmetry, similarity, and congruence (10E-6)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R

BUILDING TRADES		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
G10. Layout, cut and install valley jack rafters	Understanding Numbers	
	• Apply number theory concepts (9A-7)	R
	Computation	
	• Recall fraction/decimal/percent equivalents (7B-1)	R
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems requiring the application of the Pythagorean theorem (10D-5)	R
	• Convert units of measure within a system (6D-9)	R
	Geometry	
G11. Frame dormers	• Solve problems using measures of inclination (9E-6)	R
	• Solve problems using the concepts of symmetry, similarity, and congruence (10E-6)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R

BUILDING TRADES		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
G12. Layout, cut and install gable studs	Measurement	
	Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Compute the area and perimeter of irregularly shaped figures (9D-5)	R
	Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
G13. Construct intersecting gable roof	Consumer Problems	
	Solve problems involving area and perimeter in consumer situations (8H-3)	R
	Measurement	
	Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Compute the area and perimeter of irregularly shaped figures (9D-5)	R
	Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	Consumer Problems	
	Solve problems involving area and perimeter in consumer situations (8H-3)	R

BUILDING TRADES		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
G16. Frame roof openings	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Compute the area and perimeter of irregularly shaped figures (9D-5)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	Consumer Problems	
	• Solve problems involving area and perimeter in consumer situations (8H-3)	R

BUILDING TRADES		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
G17. Layout, construct and install knee wall	Computation • Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Estimation • Solve problems utilizing estimation (9C-5)	R
	Measurement • Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Compute the area and perimeter of irregularly shaped figures (9D-5) • Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	Consumer Problems • Solve problems involving area and perimeter in consumer situations (8H-3)	R

BUILDING TRADES		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
G18. Construct box cornice	Computation	
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Compute the area and perimeter of irregularly shaped figures (9D-5)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	• Solve problems involving measurement (volume) (9D-11)	R
	Consumer Problems	
	• Solve problems using proportion in consumer situations (9H-2)	R
	• Solve problems involving area and perimeter in consumer situations (8H-3)	R

BUILDING TRADES		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
G19. Construct rake cornice	Understanding Numbers Use mathematical relationships to simplify expressions (9A-5)	R
	Computation Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Compute the area and perimeter of irregularly shaped figures (9D-5)	R
	Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	Solve problems involving measurement (volume) (9D-11)	R
	Consumer Problems - Solve problems using proportion in consumer situations (9H-2) - Solve problems involving area and perimeter in consumer situations (8H-3)	R

BUILDING TRADES		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
H3. Install step flashing	Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Compute the area and perimeter of irregularly shaped figures (9D-5) - Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6) Consumer Problems - Solve problems involving area and perimeter in consumer situations (8H-3)	R R R R
H4. Install valley flashing	Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Compute the area and perimeter of irregularly shaped figures (9D-5) - Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6) Consumer Problems - Solve problems involving area and perimeter in consumer situations (8H-3)	R R R R

BUILDING TRADES		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
H9. Install composite shingles in valley	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Compute the area and perimeter of irregularly shaped figures (9D-5)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
H10. Install composite shingles around roof openings	Consumer Problems	
	• Solve problems involving area and perimeter in consumer situations (8H-3)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Compute the area and perimeter of irregularly shaped figures (9D-5)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	Consumer Problems	
	• Solve problems involving area and perimeter in consumer situations (8H-3)	R

BUILDING TRADES		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
H11. Install shingles over dormer or roof appendage	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Compute the area and perimeter of irregularly shaped figures (9D-5)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
H12. Install composite shingles on ridge cap	Consumer Problems	
	• Solve problems involving area and perimeter in consumer situations (8H-3)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Compute the area and perimeter of irregularly shaped figures (9D-5)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	Consumer Problems	
	• Solve problems involving area and perimeter in consumer situations (8H-3)	R

BUILDING TRADES		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
14. Hang exterior door	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Compute the area and perimeter of irregularly shaped figures (9D-5)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
15. Install weatherstripping	Consumer Problems	
	• Solve problems involving area and perimeter in consumer situations (8H-3)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Compute the area and perimeter of irregularly shaped figures (9D-5)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	Consumer Problems	
	• Solve problems involving area and perimeter in consumer situations (8H-3)	R

BUILDING TRADES		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
16. Install pre-hung exterior door	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Compute the area and perimeter of irregularly shaped figures (9D-5)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
17. Install drip cap	Consumer Problems	
	• Solve problems involving area and perimeter in consumer situations (8H-3)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Compute the area and perimeter of irregularly shaped figures (9D-5)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	Consumer Problems	
	• Solve problems involving area and perimeter in consumer situations (8H-3)	R

BUILDING TRADES		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
I14. Install metal or vinyl fascia	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Compute the area and perimeter of irregularly shaped figures (9D-5)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
I15. Install wood fascia	Consumer Problems	
	• Solve problems involving area and perimeter in consumer situations (8H-3)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Compute the area and perimeter of irregularly shaped figures (9D-5)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	Consumer Problems	
	• Solve problems involving area and perimeter in consumer situations (8H-3)	R

BUILDING TRADES		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
118. Install prefabricated storm doors and windows	Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Compute the area and perimeter of irregularly shaped figures (9D-5) - Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	Consumer Problems Solve problems involving area and perimeter in consumer situations (8H-3)	R
119. Install fixed exterior shutters	Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Compute the area and perimeter of irregularly shaped figures (9D-5) - Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	Consumer Problems Solve problems involving area and perimeter in consumer situations (8H-3)	R

BUILDING TRADES		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
I24. Install wood newel post, balusters and railings	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Compute the area and perimeter of irregularly shaped figures (9D-5)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
I25. Layout, cut and install porches and decks	Consumer Problems	
	• Solve problems involving area and perimeter in consumer situations (8H-3)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Compute the area and perimeter of irregularly shaped figures (9D-5)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	Consumer Problems	
	• Solve problems involving area and perimeter in consumer situations (8H-3)	R

BUILDING TRADES		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
J3. Install plank flooring	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Compute the area and perimeter of irregularly shaped figures (9D-5)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
J4. Install tongue and groove flooring	Consumer Problems	
	• Solve problems involving area and perimeter in consumer situations (8H-3)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Compute the area and perimeter of irregularly shaped figures (9D-5)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	Consumer Problems	
	• Solve problems involving area and perimeter in consumer situations (8H-3)	R

BUILDING TRADES		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
J7. Hang drywall (gypsum) over wood or metal studs	Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Compute the area and perimeter of irregularly shaped figures (9D-5) - Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6) Consumer Problems - Solve problems involving area and perimeter in consumer situations (8H-3)	R R R R
J8. Install interior door jamb	Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Compute the area and perimeter of irregularly shaped figures (9D-5) - Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6) Consumer Problems - Solve problems involving area and perimeter in consumer situations (8H-3)	R R R R

BUILDING TRADES		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
J11. Case interior openings	Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Compute the area and perimeter of irregularly shaped figures (9D-5) - Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6) Consumer Problems - Solve problems involving area and perimeter in consumer situations (8H-3)	R R R R
J12. Install pre-hung door unit (split jamb)	Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Compute the area and perimeter of irregularly shaped figures (9D-5) - Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6) Consumer Problems - Solve problems involving area and perimeter in consumer situations (8H-3)	R R R R

BUILDING TRADES		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
J13. Install double-acting door	Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Compute the area and perimeter of irregularly shaped figures (9D-5) - Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6) Consumer Problems - Solve problems involving area and perimeter in consumer situations (8H-3)	R R R R
J14. Install folding (accordion) door	Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Compute the area and perimeter of irregularly shaped figures (9D-5) - Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6) Consumer Problems - Solve problems involving area and perimeter in consumer situations (8H-3)	R R R R

BUILDING TRADES		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
J19. Install cylinder lock set	Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Compute the area and perimeter of irregularly shaped figures (9D-5) - Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6) Consumer Problems - Solve problems involving area and perimeter in consumer situations (8H-3)	R R R R
J20. Install mortise lock set	Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Compute the area and perimeter of irregularly shaped figures (9D-5) - Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6) Consumer Problems - Solve problems involving area and perimeter in consumer situations (8H-3)	R R R R

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BUILDING TRADES		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
J27. Install closet accessories	Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Compute the area and perimeter of irregularly shaped figures (9D-5) - Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6) Consumer Problems - Solve problems involving area and perimeter in consumer situations (8H-3)	R R R R
J28. Assemble prefabricated cabinets	Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Compute the area and perimeter of irregularly shaped figures (9D-5) - Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6) Consumer Problems - Solve problems involving area and perimeter in consumer situations (8H-3)	R R R R

BUILDING TRADES		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
J35. Install suspended T-grid ceiling	Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Compute the area and perimeter of irregularly shaped figures (9D-5) - Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6) Consumer Problems - Solve problems involving area and perimeter in consumer situations (8H-3)	R R R R
J36. Install suspended concealed grid ceiling	Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Compute the area and perimeter of irregularly shaped figures (9D-5) - Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6) Consumer Problems - Solve problems involving area and perimeter in consumer situations (8H-3)	R R R R

BUILDING TRADES		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
K1. Layout, cut and install stringers	Measurement	R
	- Choose the appropriate unit of precision for a given measurement situation (7D-1) - Solve problems requiring the application of the Pythagorean theorem (10D-5)	R
	Geometry	R
	- Recognize properties and relationships of lines and of angles (parallel and perpendicular lines, complementary and supplementary angles, alternate interior and corresponding angles, calculate third angle of a triangle) (10E-1) - Solve problems using measures of inclination (9E-6)	R
K2. Install treads and risers	Measurement	R
	- Choose the appropriate unit of precision for a given measurement situation (7D-1) - Compute the area and perimeter of irregularly shaped figures (9D-5) - Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	Consumer Problems	R
	Solve problems involving area and perimeter in consumer situations (8H-3)	R

BUILDING TRADES		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
K3. Construct box stairs	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Compute the area and perimeter of irregularly shaped figures (9D-5)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
K4. Install wood newel post, balusters and railing (handrail)	Consumer Problems	
	• Solve problems involving area and perimeter in consumer situations (8H-3)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Compute the area and perimeter of irregularly shaped figures (9D-5)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	Consumer Problems	
	• Solve problems involving area and perimeter in consumer situations (8H-3)	R

BUILDING TRADES		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
K5. Install metal newel post and railing (interior newel post)	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Compute the area and perimeter of irregularly shaped figures (9D-5)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
K6. Install prefabricated stairs	Consumer Problems	
	• Solve problems involving area and perimeter in consumer situations (8H-3)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Compute the area and perimeter of irregularly shaped figures (9D-5)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	Consumer Problems	
	• Solve problems involving area and perimeter in consumer situations (8H-3)	R

BUILDING TRADES		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
K7. Install skirtboard	Measurement	
	Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Compute the area and perimeter of irregularly shaped figures (9D-5)	R
	Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	Consumer Problems	
	Solve problems involving area and perimeter in consumer situations (8H-3)	R

APPENDIX:

Additional Math Skills Information

Based on
1990 Core Competencies And Key Skills
For Missouri Schools

Mathematics
Grade 2-10

GRADE LEVEL 2	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
2	2 Compare whole numbers 3 Identify place value a the digit in the ones', tens', or hundreds' place b the place value of a given digit by name c the value of a digit in the ones', tens', or hundreds' place 4 Complete and create patterns a number b geometric c graphic 6 Identify fractional parts	2 Add whole numbers 3 Subtract whole numbers 7 Explore the use of open sentences to describe mathematical relationships a involving addition b involving subtraction c which represent given computational situations		3 Tell and record time	1 Describe, model, draw, and classify shapes a rectangles and squares b circles c triangles	2 Construct, read, and interpret displays of data a bar graphs b pictographs c other displays of data		2 Solve word problems involving addition 3 Solve word problems involving subtraction

GRADE LEVEL 3	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
3	2 Compare numbers a compare two numbers using < or > b order a set of numbers by magnitude 3 Identify place value a the digit in the ones', tens', hundreds', or thousands' place b the place value of a given digit by name c the value of a digit in the ones', tens', hundreds', or thousands' place 6 Identify fractional parts	4 Add and subtract whole numbers with regrouping 5 Multiply whole numbers 7 Explore the use of open sentences to describe mathematical relationships a involving addition b involving subtraction c involving multiplication and division d identify open sentences that represent given computational situations		3 Tell and record time a relate various recording conventions to each other 5 Measure length, weight (mass), volume, and capacity using nonstandard and standard units a nearest inch b nearest centimeter c nearest pound or kilogram d nearest cup, pint, quart, gallon, and liter	2 Identify cones, cylinders, spheres, pyramids, and cubes	2 Construct, read, and interpret displays of data a read bar graphs and pictographs b contrast displays of data c interpret displays of data 3 Locate points on a grid		2 Solve word problems involving addition and subtraction of money 4 Solve word problems using addition, subtraction, and multiplication

GRADE LEVEL 4	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
4	3 Identify place value a the digit in the ones', tens', hundreds', thousands', or ten thousands' place b the place value of a given digit by name through ten thousands c the value of a specified digit(s) through the ten thousands' place 6 Graph points representing fractions on a number line a select the fraction represented by a given point on a number line b select the point on a number line representing a given fraction	4 Add and subtract whole numbers with up to four addends 5 Multiply whole numbers (3-digit by 1-digit) 7 Use open sentences to express mathematical relationships a identify the open sentence which represents a computational situation involving addition and/or subtraction, and multiplication and/or division b identify the computational situation which represents an open sentence involving addition and/or subtraction and multiplication and/or division	3 Recognize a situation in which an estimate or an exact answer is appropriate	2 Estimate measurements including area and perimeter of regular and irregular regions 5 Measure lengths a to the nearest half inch b to the nearest centimeter	2 Explore properties of right angles	2 Construct, read, and interpret displays of data a select bar graphs and pictographs b contrast displays of data		2 Solve problems involving money management a with computational algorithms b which may require nonstandard strategies 4 Solve standard multi-step word problems, using one or more than one operation 5 Solve nonstandard word problems

GRADE LEVEL 5	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
5	2 Compare unit fractions a compare two fractions using $<$ or $>$ b order a set of fractions by magnitude 3 Compare decimals a compare two decimals using $<$, $>$, or $=$ b order a set of decimals by magnitude 7 Apply number theory concepts a factors b multiples	5 Multiply and divide whole numbers (3-digit by 2-digit) 7 Solve number sentences a involving addition and subtraction with whole numbers and/or decimals b involving multiplication and division with whole numbers with 1-digit multipliers and divisors 8 Add and subtract like fractions	2 Use estimation strategies and mental computation to determine whether an answer is reasonable	2 Estimate measurements a linear measure b area, mass, and volume measures 6 Measure area and perimeter of regular and irregular regions using nonstandard and standard units 9 Convert units of measure within a system a metric system b English system	1 Identify properties of lines a intersecting, parallel, and perpendicular lines b vertical, horizontal, and diagonal (oblique) lines 4 Compare and classify geometric shapes and solids a similar figures b congruent figures c identify a figure with a specified number of lines of symmetry d regular polygons e right triangles	1 Systematically collect, organize, and describe data a best method for collecting data b accurate organization of given data c describe data using ratio and proportion 2 Construct, read, and interpret displays of data a identify graphs that accurately represent given data b interpret displays of data c construct displays of data		4 Solve standard multi-step word problems 5 Solve nonstandard word problems

GRADE LEVEL 6	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
6	2 Compare fractions and decimals a compare two fractions using $<$, $>$, or $=$ b compare two decimals using $<$, $>$, or $=$ c order a set of fractions or decimals by magnitude 4 Compare a numerical sequence 6 Graph points representing positive rational numbers on a number line a select the fraction or decimal represented by a given point b select the point representing a given fraction or decimal	6 Add, subtract, multiply, and divide whole numbers 7 Solve number sentences a involving whole numbers and decimals b involving whole numbers and like fractions 8 Multiply fractions a whole numbers and fractions b fractions with denominators less than 10 9 Use operations in the correct order		1 Choose an appropriate unit of measure and the corresponding tool for a given situation a within the metric system b within the English system 6 Calculate areas and perimeters a of squares and rectangles 9 Convert units of measure within a system a metric system b English system	4 Compare and classify geometric shapes and solids a similar figures b congruent figures c identify a figure with a specified number of lines of symmetry d regular polygons e right triangles	1 Systematically collect, organize, and describe data a best method for collecting data b accurate organization of given data 2 Construct, read, and interpret displays of data a identify graphs that accurately represent given data b interpret displays of data c construct displays of data		1 Solve word problems involving money 4 Solve standard multi-step word problems 5 Solve nonstandard word problems

GRADE LEVEL 7	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
7	1 Communicate and interpret numbers a interpret calculator displays b express numbers in scientific notation with positive exponents c express large numbers in conventional notation 2 Compare positive rational numbers a compare fraction to fraction b compare decimal to fraction 5 Use numerical relationships to describe and simplify numerical situations 7 Apply number theory concepts a classify numbers as prime or composite b factors c multiples d multiple classifications	1 Recall fraction/decimal/percent equivalents 7 Solve linear equations (number sentences) a one-step b two-step 8 Compute the sum, difference, product, or quotient of fractions 9 Use operations in correct order a with + and/or - and + b with + and/or - and x 12 Compute solutions of problems involving percents a calculate percent of a number b calculate percent one number is of another c calculate the whole when a percent is given	1 Determine a reasonable estimate 2 Use estimation strategies and mental computation to determine if an answer is reasonable 5 Solve problems utilizing estimation a utilizing percents b utilizing fractions c utilizing decimals	1 Choose the appropriate unit of precision for a given measurement situation a in metric measurements b in standard measurements 2 Estimate measurement 6 Approximate and/or calculate areas and perimeters of irregularly shaped regions 10 Investigate the relationships among circumference, area, and diameter of a circle 11 Solve problems involving measurement	1 Recognize properties and relationships of lines and angles 2 Classify polygons a classify regular polygons with five or more sides b classify irregular polygons with five or more sides c classify quadrilaterals 3 Determine lines of symmetry in natural and geometric figures a in a natural figure b in a plane geometric figure 5 Identify the plane geometric figures which form the surfaces of three dimensional projects	1 Systematically collect, organize, and classify data a collect and organize statistical data b describe the most appropriate measure c determine mean d determine median e determine mode f determine range 2 Construct, read, and interpret displays of data a construct graphic data displays b identify correctly constructed bar and line graphs, pie charts, pictographs, and scattergrams c interpret bar and line graphs, pie charts, pictographs, and scattergrams 3 Formulate and solve problems that involve collecting and analyzing data	1 Create a problem to illustrate a given numerical sentence 2 Write a number sentence to illustrate a problem 3 Identify unnecessary or missing numerical data in a word problem	2 Solve problems involving percent in consumer situations a sales tax b discount c commission 4 Solve problems using ratio and proportion in consumer situations a involving pricing b involving recipe conversion c involving medication dosage d involving relative distances between locations

GRADE LEVEL 8	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
8	1 Communicate and interpret numbers a convert rational numbers to scientific notation b convert scientific notation to rational numbers 2 Compare rational numbers a compare fraction to fraction b compare decimal to fraction 5 Use mathematical relationships to describe and simplify mathematical expressions 7 Apply number theory a determine powers b determine square roots c determine cube roots	6 Compute the sum, difference, product, or quotient of integers 7 Solve linear equations a one-step b two-step 9 Evaluate algebraic expressions, given values for the variables	2 Use estimation strategies and mental computation to determine if an answer is reasonable 5 Solve problems utilizing estimation a utilizing percents b utilizing fractions c utilizing decimals	2 Estimate measurement 6 Calculate the perimeter or the area of a triangle, rectangle, or square 10 Calculate the circumference or the area of a circle 11 Solve problems involving measurement	1 Recognize properties and relationships of lines and angles a identify bisectors b identify radii c identify diagonals d identify diameters e identify interior angles f identify exterior angles 2 Classify polygons a classify triangles by sides/angles b classify quadrilaterals (e.g., parallelogram, rectangle, rhombus, trapezoid) 3 Recognize similar and congruent figures 5 Visualize, draw, and construct geometric figures	3 Formulate and solve problems that involve collecting and analyzing data 4 Calculate and interpret the probability of an event	1 Create a word problem to illustrate a given equation, or write an equation to illustrate a given problem 4 Follow a series of instructions in sequential order a in a flow chart b in a diagram c in a narrative	1 Solve problems involving money in consumer situations a involving simple interest b involving total cost of installment purchases c involving total cost of purchases including sales tax d involving discounts e involving sale prices 3 Solve problems involving area and perimeter in consumer situations 4 Solve problems using proportion in consumer situations a involving pricing b involving recipe conversion c involving medication dosage d involving relative distances between locations

GRADE LEVEL 9	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
9	5 Use mathematical relationships to simplify expressions a mathematical expressions b algebraic expressions 7 Apply number theory concepts	2 Compute using scientific notation 7 Solve linear equations a one/two steps with integral coefficients and integral or rational solutions	2 Judge reasonableness of solutions or estimates of solutions to problems 4 Determine the relative magnitude of fractional numbers 5 Solve problems utilizing estimation a consumer situations b practical situations	5 Compute the area and perimeter of irregularly shaped figures 11 Solve problems involving measurement a volume of cylinders b volume of rectangular solids	1 Recognize properties and relationships of lines and angles 4 Determine if a given point is on the graph of a given equation 5 Visualize, draw, and construct geometric figures 6 Solve problems using measures of inclination: (slope)	2 Calculate and interpret the probability of an event 3 Formulate and solve problems that involve collecting and analyzing statistical data a draw inferences b evaluate conclusions c solve problems involving mean, median, mode, and range 4 Judge the reliability of inferences drawn from statistical data	1 Translate word phrases and sentences into algebraic expressions and equations 2 Evaluate the validity of conclusions drawn from given premises and definitions 3 Identify impediments to solving a given problem a information to solve a problem b information missing to solve a problem c information unnecessary to solve a problem d information that needs to be converted to another form	1 Solve problems involving volume and area in consumer situations 2 Solve problems using proportion in consumer situations a involving pricing b involving food, recipes, and nutrition c involving medication dosage d involving relative distances between locations 3 Investigate problems involving personal finance 4 Compute gross pay using hourly, monthly, commission, piecework, and/or overtime rates

GRADE LEVEL 10	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
10	5 Use mathematical relationships to simplify expressions - a mathematical expressions - b algebraic expressions	7 Solve linear equations - a with decimal coefficients - b with fractional coefficients - c with integral coefficients 10 Solve formulas for a given variable	1 Estimate solutions for various computational problems - a using scientific notation - b using whole numbers - c using fractions - d using decimals 2 Judge reasonableness of solutions 5 Solve problems utilizing estimation - a on consumer situations - b on practical situations	5 Solve problems requiring the application of the Pythagorean theorem - a given diagrams and measurements of right triangles - b given a situation involving a right triangle 11 Solve problems involving measurement	1 Recognize properties and relationships of lines and angles - a parallel and perpendicular lines - b complementary and supplementary angles - c alternate interior and corresponding angles - d calculate the third angle of a triangle 3 Graph equations - a plot the graph of a linear equation - b identify the graph of a linear equation - c identify the slope of a line given its graph and equation - d use the graph of a line to identify its equation 5 Visualize, draw, and construct geometric figures 6 Solve problems using the concepts of symmetry, similarity, and congruence - a determine lines of symmetry - b use the concept of congruence	2 Calculate and interpret the probability of an event 3 Identify limitations of an inference drawn from statistical data - a limitations to an inference - b additional information needed - c demonstrable bias	1 State logical conclusions from given conditions 2 Evaluate the acceptability of a conclusion drawn through logical inference	2 Solve banking problems related to maintaining a checking account 4 Use appropriate information and tables to compute net pay, considering Social Security deductions, state and federal taxes, etc.

INTEGRATING VOCATIONAL COMPETENCIES AND MATH SKILLS

DRAFTING

Available from the
Instructional Materials Laboratory
University of Missouri-Columbia
10 London Hall
Columbia, Missouri 65211
314-882-2883
Catalog Number 65-7500-I

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FOREWORD

National interest and legislation support the need for identifying core competencies and key skills taught in industrial education classes. An understanding of the basic competencies involved will help identify academic subjects as they relate to specific occupations.

The following program area/math skills matrix can therefore be a valuable resource for program integration of academics, pre-testing and skills assessment, and special needs curriculum development. It identifies the math core competencies and key skills required for/taught in one of ten program areas at the Missouri secondary level. Matrices were developed for: Air Conditioning, Heating, and Refrigeration; Auto Collision Technology; Automotive Technology; Building Trades; Drafting; Electronics; Graphic Arts (Offset Lithography); Health Services Assistant; Machine Technology; and Welding.

The materials used to create the matrix include: the 1990 Core Competencies and Key Skills for Missouri Schools, grades two through ten; and Instructional Materials Laboratory vocational program competency profiles for the program areas involved.

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TO THE INSTRUCTOR: SUGGESTIONS FOR USE

The matrix that follows is divided into three columns. Reading in a row across all three of the columns will identify which math skills are involved in each vocational competency and tell whether the math skills are new to students or simply need reinforcement.

The first column identifies the vocational competencies involved in the program area. The numbers and competencies in this column refer to the Instructional Materials Laboratory competency profile for the program area.

The second column identifies which math skills are involved in the vocational competencies. The skills and numbers listed in this column refer to the 1990 Core Competencies and Key Skills for Missouri Schools, grades two through ten. (The list can also stand alone as a general list of math skills.) The column is blank for any vocational competency that the committee members decided did not require math skills.

Additional information about the math skills listed in the second column of the matrix may be found in the appendix following the matrix. The appendix is based on the math skills identified in the 1990 Core Competencies and Key Skills for Missouri Schools.

The last column tells whether the math skills will be new to students in the vocational classroom or whether they have been covered by math courses in the second through tenth grades. You may want to review and/or reinforce the math skills that students already have, and to make arrangements for them to learn the skills that are new to them.

As you use the matrix to help students learn or review math skills, keep in mind that different students learn in different ways. Efforts should be made to ensure that all students have an equal opportunity to understand and learn the material, regardless of race, color, national origin, gender, age, or disability.

Hold high expectations for all students, and provide the instruction necessary for students to meet those expectations. It is important that students achieve in math because research has shown a link between attitude toward mathematics and science, self-esteem levels, and career aspirations. According to a survey by the American Association of University Women: "Girls and boys who like mathematics and science have higher self-esteem, more ambitious career goals, and are more likely to hold onto their dreams."

As you help students achieve and develop this positive attitude toward mathematics, be aware that students of different genders give different reasons for their lack of interest in math. The AAUW survey states: "The gender differences in the intertwining of self-esteem and math/science interest is most evident in girls' and boys' reasons for their declining interest in math and science. While boys 'externalize' by seeing math and science as unimportant, girls 'internalize' by thinking themselves not smart enough."

DRAFTING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
A1. Apply safety policies and procedures		
A2. *		
A3. Identify American National Standards Institute, Inc. (ANSI) and International Standards Organization (ISO) standards (terminology)		
A4. Identify drafting occupations and related fields		
A5. Apply recordkeeping procedures		
A6. Identify drafting terminology		
B1. Select proper drawing instruments and equipment to complement the drafting media; i.e., Mylar, Vellum		
B2. Demonstrate proper use and care of drawing instruments and equipment		
B3. Produce electrostatic (i.e., stick-on decals), sepia, and blue-line copies		
B4. *		
B5. *		
B6. Adjust drafting machine and equipment	Geometry Recognize properties and relationships of lines and angles (9E-1)	R

DRAFTING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
C1. Layout drawing	Computation • Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement • Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (8D-11)	R
	Graphing and Statistics • Construct, read, and interpret displays of data (7F-2)	R
C2. Construct borders and information blocks	Computation • Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement • Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (8D-11)	R
	Problem Solving • Identify impediments to solving a given problem (9G-3)	R

DRAFTING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
C3. Construct freehand sketches	Measurement	R
	Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Solve problems involving measurement (8D-11)	R
	Geometry	R
	Recognize properties and relationships of lines and angles (identify bisectors, radii, diagonals, diameters, interior and exterior angles) (8E-1)	R
C4. Read and transfer measurements	Consumer Problems	R
	Solve problems using proportion in consumer situations (9H-2)	R
	Solve problems using ratio and proportion in consumer situations (7H-4)	R
	Computation	R
	Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement	R
	Choose the appropriate unit of precision for a measurement situation (7D-1)	R
	Estimate measurement (8D-2)	R
	Solve problems involving measurement (8D-11)	R

DRAFTING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
C5. Letter freehand (letters and numerals)		
C6. Demonstrate techniques in line construction		
C7. Letter with mechanical lettering devices and templates		

DRAFTING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
C8. Construct a drawing with mechanical pencils	Computation	
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	• Compute the sum, difference, product or quotient of fractions (7B-8)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R
	• Solve problems involving measurement (8D-11)	R
	• Solve problems involving measurement (volume) (9D-11)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (identify bisectors, radii, diagonals, diameters, interior and exterior angles) (8E-1)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Identify impediments to solving a given problem (9G-3)	R

DRAFTING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
C8. Construct a drawing with mechanical pencils (cont'd.)	Consumer Problems	R
	- Solve problems using proportion in consumer situations (9H-2) - Solve problems using ratio and proportion in consumer situations (7H-4)	R
C9. Construct a drawing with technical ink pens		
C10. Construct a tracing using reproduction techniques and materials		
D1. Bisect lines, angles and arcs	Measurement	R
	Solve problems involving measurement (8D-11)	
	Geometry	R
	- Recognize properties and relationships of lines and angles (7E-1) - Recognize properties and relationships of lines and of angles (parallel and perpendicular lines, complementary and supplementary angles, alternate interior and corresponding angles, calculate third angle of a triangle) (10E-1)	R

DRAFTING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
E3. Prepare orthographic drawing (3rd angle) (cont'd.)	Geometry	
	• Recognize properties and relationships of lines and angles (identify bisectors, radii, diagonals, diameters, interior and exterior angles) (8E-1)	R
	• Recognize properties and relationships of lines and of angles (parallel and perpendicular lines, complementary and supplementary angles, alternate interior and corresponding angles, calculate third angle of a triangle) (10E-1)	R
	• Classify polygons (regular and irregular) (7E-2)	R
	• Classify polygons (triangles and quadrilaterals) (8E-2)	R
	• Visualize, draw, and construct geometric figures (10E-5)	R
	• Solve problems using the concepts of symmetry, similarity, and congruence (10E-6)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Identify impediments to solving a given problem (9G-3)	R

DRAFTING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
F3. Construct secondary auxiliary views	Geometry - Recognize properties and relationships of lines and angles (7E-1)* - Visualize, draw, and construct geometric figures (10E-5)	R R
F4. Identify use and application of auxiliary views		
G1. Identify and draw standard sectional views		
G2. Identify the symbols used to represent different materials		
G3. Identify and use cutting planes		
G4. Identify and use conventional breaks		
G5. Identify use and application of sectional views		
H1. Apply dimensioning practices and techniques to drawings		
H2. Construct the lines used to dimension drawings		
H3. Identify use and application of dimensioning practices		

DRAFTING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
H4. Identify tolerancing	Computation - Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6) - Compute the sum, difference, product, or quotient of integers (8B-6) Estimation - Judge reasonableness of solutions (10C-2) Graphing and Statistics - Construct, read, and interpret displays of data (7F-2)	R R R R
H5. Read and convert measurements	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) - Compare rational numbers (8A-2) - Identify place value (4A-3) Measurement - Solve problems involving measurement (8D-11) Consumer Problems - Solve problems using ratio and proportion in consumer situations (7H-4)	R R R R R R
H6. Identify geometric dimensioning and tolerancing techniques	Estimation - Judge reasonableness of solutions (10C-2) Graphing and Statistics - Construct, read, and interpret displays of data (7F-2)	R R

DRAFTING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
H7. Apply geometric dimensioning and tolerancing techniques	Computation	R
	- Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6) - Solve formulas for a given variable (10B-10)	R
	Estimation	R
	Graphing and Statistics Construct, read, and interpret displays of data (7F-2)	R
I1. Perform graphic solutions of points	Geometry	R
	- Recognize properties and relationships of lines and of angles (parallel and perpendicular lines, complementary and supplementary angles, alternate interior and corresponding angles, calculate third angle of a triangle) (10E-1) - Visualize, draw, and construct geometric figures (10E-5)	R

DRAFTING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
I2. Perform graphic solutions of lines	Geometry	R
	- Recognize properties and relationships of lines and of angles (parallel and perpendicular lines, complementary and supplementary angles, alternate interior and corresponding angles, calculate third angle of a triangle) (10E-1) - Visualize, draw, and construct geometric figures (10E-5)	R
I3. Perform graphic solutions of planes	Geometry	R
	- Recognize properties and relationships of lines and of angles (parallel and perpendicular lines, complementary and supplementary angles, alternate interior and corresponding angles, calculate third angle of a triangle) (10E-1) - Visualize, draw, and construct geometric figures (10E-5)	R

DRAFTING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
14. Perform graphic solutions of solids	Geometry	R
	- Recognize properties and relationships of lines and of angles (parallel and perpendicular lines, complementary and supplementary angles, alternate interior and corresponding angles, calculate third angle of a triangle) (10E-1) - Visualize, draw, and construct geometric figures (10E-5)	R
15. Perform graphic solutions of intersections	Geometry	R
	- Recognize properties and relationships of lines and of angles (parallel and perpendicular lines, complementary and supplementary angles, alternate interior and corresponding angles, calculate third angle of a triangle) (10E-1) - Visualize, draw, and construct geometric figures (10E-5)	R

DRAFTING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
N2. Produce a simple steel framing plan drawing	Computation	R
	Solve formulas for a given variable (10B-10)	
	Measurement	R
	- Choose the appropriate unit of precision for a given measurement situation (7D-1) - Solve problems involving measurement (8D-11)	R
N3. Produce a simple detail and assembly drawing (including beam connections) with bill of materials	Problem Solving	R
	Identify impediments to solving a given problem (9G-3)	
	Computation	R
	Solve formulas for a given variable (10B-10)	
	Measurement	R
	- Choose the appropriate unit of precision for a given measurement situation (7D-1) - Solve problems involving measurement (8D-11)	R
	Problem Solving	R
	Identify impediments to solving a given problem (9G-3)	

DRAFTING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
S3. Apply basic trigonometric principles	Computation Solve formulas for a given variable (10B-10)	R
	Measurement Solve problems requiring the application of the Pythagorean theorem (10D-5)	R
	Geometry Classify polygons (triangles and quadrilaterals) (8E-2)	R

APPENDIX:
Additional Math Skills Information

**Based on
1990 Core Competencies And Key Skills
For Missouri Schools**

**Mathematics
Grade 2-10**

GRADE LEVEL 2	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
2	2 Compare whole numbers 3 Identify place value a the digit in the ones', tens', or hundreds' place b the place value of a given digit by name c the value of a digit in the ones', tens', or hundreds' place 4 Complete and create patterns a number b geometric c graphic 6 Identify fractional parts	2 Add whole numbers 3 Subtract whole numbers 7 Explore the use of open sentences to describe mathematical relationships a involving addition b involving subtraction c which represent given computational situations		3 Tell and record time	1 Describe, model, draw, and classify shapes a rectangles and squares b circles c triangles	2 Construct, read, and interpret displays of data a bar graphs b pictographs c other displays of data		2 Solve word problems involving addition 3 Solve word problems involving subtraction

GRADE LEVEL 3	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
3	2 Compare numbers a compare two numbers using < or > b order a set of numbers by magnitude 3 Identify place value a the digit in the ones', tens', hundreds', or thousands' place b the place value of a given digit by name c the value of a digit in the ones', tens', hundreds', or thousands' place 6 Identify fractional parts	4 Add and subtract whole numbers with regrouping 5 Multiply whole numbers 7 Explore the use of open sentences to describe mathematical relationships a involving addition b involving subtraction c involving multiplication and division d identify open sentences that represent given computational situations		3 Tell and record time a relate various recording conventions to each other 5 Measure length, weight (mass), volume, and capacity using nonstandard and standard units a nearest inch b nearest centimeter c nearest pound or kilogram d nearest cup, pint, quart, gallon, and liter	2 Identify cones, cylinders, spheres, pyramids, and cubes	2 Construct, read, and interpret displays of data a read bar graphs and pictographs b contrast displays of data c interpret displays of data 3 Locate points on a grid		2 Solve word problems involving addition and subtraction of money 4 Solve word problems using addition, subtraction, and multiplication

GRADE LEVEL 4	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
4	3 Identify place value a the digit in the ones', tens', hundreds', thousands', or ten thousands' place b the place value of a given digit by name through ten thousands c the value of a specified digit(s) through the ten thousands' place 6 Graph points representing fractions on a number line a select the fraction represented by a given point on a number line b select the point on a number line representing a given fraction	4 Add and subtract whole numbers with up to four addends 5 Multiply whole numbers (3-digit by 1-digit) 7 Use open sentences to express mathematical relationships a identify the open sentence which represents a computational situation involving addition and/or subtraction, and multiplication and/or division b identify the computational situation which represents an open sentence involving addition and/or subtraction and multiplication and/or division	3 Recognize a situation in which an estimate or an exact answer is appropriate	2 Estimate measurements including area and perimeter of regular and irregular regions 5 Measure lengths a to the nearest half inch b to the nearest centimeter	2 Explore properties of right angles	2 Construct, read, and interpret displays of data a select bar graphs and pictographs b contrast displays of data		2 Solve problems involving money management a with computational algorithms b which may require nonstandard strategies 4 Solve standard multi-step word problems, using one or more than one operation 5 Solve nonstandard word problems

GRADE LEVEL 5	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
5	2 Compare unit fractions a compare two fractions using $<$ or $>$ b order a set of fractions by magnitude 3 Compare decimals a compare two decimals using $<$, $>$, or $=$ b order a set of decimals by magnitude 7 Apply number theory concepts a factors b multiples	5 Multiply and divide whole numbers (3-digit by 2-digit) 7 Solve number sentences a involving addition and subtraction with whole numbers and/or decimals b involving multiplication and division with whole numbers with 1-digit multipliers and divisors 8 Add and subtract like fractions	2 Use estimation strategies and mental computation to determine whether an answer is reasonable	2 Estimate measurements a linear measure b area, mass, and volume measures 6 Measure area and perimeter of regular and irregular regions using nonstandard and standard units 9 Convert units of measure within a system a metric system b English system	1 Identify properties of lines a intersecting, parallel, and perpendicular lines b vertical, horizontal, and diagonal (oblique) lines 4 Compare and classify geometric shapes and solids a similar figures b congruent figures c identify a figure with a specified number of lines of symmetry d regular polygons e right triangles	1 Systematically collect, organize, and describe data a best method for collecting data b accurate organization of given data c describe data using ratio and proportion 2 Construct, read, and interpret displays of data a identify graphs that accurately represent given data b interpret displays of data c construct displays of data		4 Solve standard multi-step word problems 5 Solve nonstandard word problems

GRADE LEVEL 6	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
6	2 Compare fractions and decimals a compare two fractions using $<$, $>$, or $=$ b compare two decimals using $<$, $>$, or $=$ c order a set of fractions or decimals by magnitude 4 Compare a numerical sequence 6 Graph points representing positive rational numbers on a number line a select the fraction or decimal represented by a given point b select the point representing a given fraction or decimal	6 Add, subtract, multiply, and divide whole numbers 7 Solve number sentences a involving whole numbers and decimals b involving whole numbers and like fractions 8 Multiply fractions a whole numbers and fractions b fractions with denominators less than 10 9 Use operations in the correct order		1 Choose an appropriate unit of measure and the corresponding tool for a given situation a within the metric system b within the English system 6 Calculate areas and perimeters a of squares and rectangles 9 Convert units of measure within a system a metric system b English system	4 Compare and classify geometric shapes and solids a similar figures b congruent figures c identify a figure with a specified number of lines of symmetry d regular polygons e right triangles	1 Systematically collect, organize, and describe data a best method for collecting data b accurate organization of given data 2 Construct, read, and interpret displays of data a identify graphs that accurately represent given data b interpret displays of data c construct displays of data		1 Solve word problems involving money 4 Solve standard multi-step word problems 5 Solve nonstandard word problems

GRADE LEVEL 7	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
7	1 Communicate and interpret numbers a interpret calculator displays b express numbers in scientific notation with positive exponents c express large numbers in conventional notation 2 Compare positive rational numbers a compare fraction to fraction b compare decimal to fraction 5 Use numerical relationships to describe and simplify numerical situations 7 Apply number theory concepts a classify numbers as prime or composite b factors c multiples d multiple classifications	1 Recall fraction/decimal/percent equivalents 7 Solve linear equations (number sentences) a one-step b two-step 8 Compute the sum, difference, product, or quotient of fractions 9 Use operations in correct order a with + and/or - and + b with + and/or - and x 12 Compute solutions of problems involving percents a calculate percent of a number b calculate percent one number is of another c calculate the whole when a percent is given	1 Determine a reasonable estimate 2 Use estimation strategies and mental computation to determine if an answer is reasonable 5 Solve problems utilizing estimation a utilizing percents b utilizing fractions c utilizing decimals	1 Choose the appropriate unit of precision for a given measurement situation a in metric measurements b in standard measurements 2 Estimate measurement 6 Approximate and/or calculate areas and perimeters of irregularly shaped regions 10 Investigate the relationships among circumference, area, and diameter of a circle 11 Solve problems involving measurement	1 Recognize properties and relationships of lines and angles 2 Classify polygons a classify regular polygons with five or more sides b classify irregular polygons with five or more sides c classify quadrilaterals 3 Determine lines of symmetry in natural and geometric figures a in a natural figure b in a plane geometric figure 5 Identify the plane geometric figures which form the surfaces of three dimensional projects	1 Systematically collect, organize, and classify data a collect and organize statistical data b describe the most appropriate measure c determine mean d determine median e determine mode f determine range 2 Construct, read, and interpret displays of data a construct graphic data displays b identify correctly constructed bar and line graphs, pie charts, pictographs, and scattergrams c interpret bar and line graphs, pie charts, pictographs, and scattergrams 3 Formulate and solve problems that involve collecting and analyzing data	1 Create a problem to illustrate a given numerical sentence 2 Write a number sentence to illustrate a problem 3 Identify unnecessary or missing numerical data in a word problem	2 Solve problems involving percent in consumer situations a sales tax b discount c commission 4 Solve problems using ratio and proportion in consumer situations a involving pricing b involving recipe conversion c involving medication dosage d involving relative distances between locations

GRADE LEVEL 8	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
8	1 Communicate and interpret numbers a convert rational numbers to scientific notation b convert scientific notation to rational numbers 2 Compare rational numbers a compare fraction to fraction b compare decimal to fraction 5 Use mathematical relationships to describe and simplify mathematical expressions 7 Apply number theory a determine powers b determine square roots c determine cube roots	6 Compute the sum, difference, product, or quotient of integers 7 Solve linear equations a one-step b two-step 9 Evaluate algebraic expressions, given values for the variables	2 Use estimation strategies and mental computation to determine if an answer is reasonable 5 Solve problems utilizing estimation a utilizing percents b utilizing fractions c utilizing decimals	2 Estimate measurement 6 Calculate the perimeter or the area of a triangle, rectangle, or square 10 Calculate the circumference or the area of a circle 11 Solve problems involving measurement	1 Recognize properties and relationships of lines and angles a identify bisectors b identify radii c identify diagonals d identify diameters e identify interior angles f identify exterior angles 2 Classify polygons a classify triangles by sides/angles b classify quadrilaterals (e.g., parallelogram, rectangle, rhombus, trapezoid) 3 Recognize similar and congruent figures 5 Visualize, draw, and construct geometric figures	3 Formulate and solve problems that involve collecting and analyzing data 4 Calculate and interpret the probability of an event	1 Create a word problem to illustrate a given equation, or write an equation to illustrate a given problem 4 Follow a series of instructions in sequential order a in a flow chart b in a diagram c in a narrative	1 Solve problems involving money in consumer situations a involving simple interest b involving total cost of installment purchases c involving total cost of purchases including sales tax d involving discounts e involving sale prices 3 Solve problems involving area and perimeter in consumer situations 4 Solve problems using proportion in consumer situations a involving pricing b involving recipe conversion c involving medication dosage d involving relative distances between locations

GRADE LEVEL 9	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
9	5 Use mathematical relationships to simplify expressions a mathematical expressions b algebraic expressions 7 Apply number theory concepts	2 Compute using scientific notation 7 Solve linear equations a one/two steps with integral coefficients and integral or rational solutions	2 Judge reasonableness of solutions or estimates of solutions to problems 4 Determine the relative magnitude of fractional numbers 5 Solve problems utilizing estimation a consumer situations b practical situations	5 Compute the area and perimeter of irregularly shaped figures 11 Solve problems involving measurement a volume of cylinders b volume of rectangular solids	1 Recognize properties and relationships of lines and angles 4 Determine if a given point is on the graph of a given equation 5 Visualize, draw, and construct geometric figures 6 Solve problems using measures of inclination: (slope)	2 Calculate and interpret the probability of an event 3 Formulate and solve problems that involve collecting and analyzing statistical data a draw inferences b evaluate conclusions c solve problems involving mean, median, mode, and range 4 Judge the reliability of inferences drawn from statistical data	1 Translate word phrases and sentences into algebraic expressions and equations 2 Evaluate the validity of conclusions drawn from given premises and definitions 3 Identify impediments to solving a given problem a information to solve a problem b information missing to solve a problem c information unnecessary to solve a problem d information that needs to be converted to another form	1 Solve problems involving volume and area in consumer situations 2 Solve problems using proportion in consumer situations a involving pricing b involving food, recipes, and nutrition c involving medication dosage d involving relative distances between locations 3 Investigate problems involving personal finance 4 Compute gross pay using hourly, monthly, commission, piecework, and/or overtime rates

GRADE LEVEL 10	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
10	5 Use mathematical relationships to simplify expressions a mathematical expressions b algebraic expressions	7 Solve linear equations a with decimal coefficients b with fractional coefficients c with integral coefficients 10 Solve formulas for a given variable	1 Estimate solutions for various computational problems a using scientific notation b using whole numbers c using fractions d using decimals 2 Judge reasonableness of solutions 5 Solve problems utilizing estimation a on consumer situations b on practical situations	5 Solve problems requiring the application of the Pythagorean theorem a given diagrams and measurements of right triangles b given a situation involving a right triangle 11 Solve problems involving measurement	1 Recognize properties and relationships of lines and angles a parallel and perpendicular lines b complementary and supplementary angles c alternate interior and corresponding angles d calculate the third angle of a triangle 3 Graph equations a plot the graph of a linear equation b identify the graph of a linear equation c identify the slope of a line given its graph and equation d use the graph of a line to identify its equation 5 Visualize, draw, and construct geometric figures 6 Solve problems using the concepts of symmetry, similarity, and congruence a determine lines of symmetry b use the concept of congruence	2 Calculate and interpret the probability of an event 3 Identify limitations of an inference drawn from statistical data a limitations to an inference b additional information needed c demonstrable bias	1 State logical conclusions from given conditions 2 Evaluate the acceptability of a conclusion drawn through logical inference	2 Solve banking problems related to maintaining a checking account 4 Use appropriate information and tables to compute net pay, considering Social Security deductions, state and federal taxes, etc.

INTEGRATING VOCATIONAL COMPETENCIES AND MATH SKILLS

ELECTRONICS

Available from the
Instructional Materials Laboratory
University of Missouri-Columbia
10 London Hall
Columbia, Missouri 65211
314-882-2883
Catalog Number 65-7500-I

December 1993

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Integrating Vocational Competencies and Math Skills is a resource designed to help teachers identify those math skills that students must master in order to complete vocational competencies found in industrial education classes. Funding for the resource development project was provided through a grant from the Missouri Department of Elementary and Secondary Education (MDESE).

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FOREWORD

National interest and legislation support the need for identifying core competencies and key skills taught in industrial education classes. An understanding of the basic competencies involved will help identify academic subjects as they relate to specific occupations.

The following program area/math skills matrix can therefore be a valuable resource for program integration of academics, pre-testing and skills assessment, and special needs curriculum development. It identifies the math core competencies and key skills required for/taught in one of ten program areas at the Missouri secondary level. Matrices were developed for: Air Conditioning, Heating, and Refrigeration; Auto Collision Technology; Automotive Technology; Building Trades; Drafting; Electronics; Graphic Arts (Offset Lithography); Health Services Assistant; Machine Technology; and Welding.

The materials used to create the matrix include: the 1990 Core Competencies and Key Skills for Missouri Schools, grades two through ten; and Instructional Materials Laboratory vocational program competency profiles for the program areas involved.

David Adams, Supervisor
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TO THE INSTRUCTOR: SUGGESTIONS FOR USE

The matrix that follows is divided into three columns. Reading in a row across all three of the columns will identify which math skills are involved in each vocational competency and tell whether the math skills are new to students or simply need reinforcement.

The first column identifies the vocational competencies involved in the program area. The numbers and competencies in this column refer to the Instructional Materials Laboratory competency profile for the program area.

The second column identifies which math skills are involved in the vocational competencies. The skills and numbers listed in this column refer to the 1990 Core Competencies and Key Skills for Missouri Schools, grades two through ten. (The list can also stand alone as a general list of math skills.) The column is blank for any vocational competency that the committee members decided did not require math skills.

Additional information about the math skills listed in the second column of the matrix may be found in the appendix following the matrix. The appendix is based on the math skills identified in the 1990 Core Competencies and Key Skills for Missouri Schools.

The last column tells whether the math skills will be new to students in the vocational classroom or whether they have been covered by math courses in the second through tenth grades. You may want to review and/or reinforce the math skills that students already have, and to make arrangements for them to learn the skills that are new to them.

As you use the matrix to help students learn or review math skills, keep in mind that different students learn in different ways. Efforts should be made to ensure that all students have an equal opportunity to understand and learn the material, regardless of race, color, national origin, gender, age, or disability.

Hold high expectations for all students, and provide the instruction necessary for students to meet those expectations. It is important that students achieve in math because research has shown a link between attitude toward mathematics and science, self-esteem levels, and career aspirations. According to a survey by the American Association of University Women: "Girls and boys who like mathematics and science have higher self-esteem, more ambitious career goals, and are more likely to hold onto their dreams."

As you help students achieve and develop this positive attitude toward mathematics, be aware that students of different genders give different reasons for their lack of interest in math. The AAUW survey states: "The gender differences in the intertwining of self-esteem and math/science interest is most evident in girls' and boys' reasons for their declining interest in math and science. While boys 'externalize' by seeing math and science as unimportant, girls 'internalize' by thinking themselves not smart enough."

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
A1. Identify various types, purposes and operation of fire extinguishers		
A2. Identify electrical hazards		
A3. Identify and practice shop safety		
A4. Identify and practice safe soldering methods		
A5. Demonstrate safe and proper use of hand tools		
A6. Identify hazard of RF radiation devices		
A7. Demonstrate safe and proper use of AC line operated equipment; i.e., isolation transformers, grounding, GFI		
B1. Describe atomic structure and its relationship to electricity	Computation - Solve linear equations (10B-7) - Solve formulas for a given variable (10B-10)	R R
B2. Describe the basic physics of semiconductor materials		
B3. Describe the relationship between electrical and magnetic properties		
B4. Describe the electrical and magnetic properties of a magnet	Computation - Solve linear equations (10B-7) - Solve formulas for a given variable (10B-10)	R R
B5. Describe the photoelectric effect		
B6. Describe the thermocouple effect		

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
B9. Describe the concept of capacitance, voltage and current and how they relate to each other	Understanding Numbers	
	• Use mathematical relationships to simplify expressions (10A-5)	R
	• Apply number theory concepts (9A-7)	R
	Computation	
	• Compute using scientific notation (9B-2)	R
	• Use operations in the correct order (7B-9)	R
	• Solve formulas for a given variable (10B-10)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Measurement	
	• Solve problems requiring the application of the Pythagorean theorem (10D-5)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
B10. Describe the concept of inductance, voltage and current and how they relate to each other	Understanding Numbers	
	• Use mathematical relationships to simplify expressions (10A-5)	R
	• Apply number theory concepts (9A-7)	R
	Computation	
	• Compute using scientific notation (9B-2)	R
	• Use operations in the correct order (7B-9)	R
	• Solve formulas for a given variable (10B-10)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Measurement	
	• Solve problems requiring the application of the Pythagorean theorem (10D-5)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
B11. Solve AC network problems utilizing appropriate theorems and laws	Understanding Numbers	
	• Use mathematical relationships to simplify expressions (10A-5)	R
	• Apply number theory concepts (9A-7)	R
	Computation	
	• Compute using scientific notation (9B-2)	R
	• Compute the sum, difference, product, or quotient of intergers (8B-6)	R
	• Use operations in the correct order (7B-9)	R
	• Solve formulas for a given variable (10B-10)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Measurement	
	• Solve problems requiring the application of the Pythagorean theorem (10D-5)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
B12. Identify and test resistors	Computation • Compute using scientific notation (9B-2) • Solve linear equations (10B-7) • Solve formulas for a given variable (10B-10) • Compute solutions of problems involving percents (7B-12) Measurement • Convert units of measure within a system (6D-9)	R R R R R
B13. Identify and test capacitors	Computation • Compute using scientific notation (9B-2) • Solve linear equations (10B-7) • Solve formulas for a given variable (10B-10) • Compute solutions of problems involving percents (7B-12) Measurement • Convert units of measure within a system (6D-9)	R R R R R
B14. Identify and test inductors	Computation • Compute using scientific notation (9B-2) • Solve linear equations (10B-7) • Solve formulas for a given variable (10B-10) • Compute solutions of problems involving percents (7B-12) Measurement • Convert units of measure within a system (6D-9)	R R R R R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
B15. Calculate series and parallel; resistive, capacitive and inductive networks	Understanding Numbers	
	• Use mathematical relationships to simplify expressions (10A-5)	R
	• Apply number theory concepts (9A-7)	R
	Computation	
	• Compute using scientific notation (9B-2)	R
	• Use operations in the correct order (7B-9)	R
	• Compute the sum, difference, product, or quotient of integers (8B-6)	R
	• Solve formulas for a given variable (10B-10)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Measurement	
	• Solve problems requiring the application of the Pythagorean theorem (10D-5)	R
	• Convert units of measure within a system (6D-9)	R
	Geometry	
	• Recognize properties and relationships of lines and of angles (10E-1)	R
	• Graph equations (10E-3)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
B19. Describe and identify filter networks	Understanding Numbers	
	• Use mathematical relationships to simplify expressions (10A-5)	R
	• Apply number theory concepts (9A-7)	R
	Computation	
	• Compute using scientific notation (9B-2)	R
	• Compute the sum, difference, product, or quotient of integers (8B-6)	R
	• Solve linear equations (10B-7)	R
	• Use operations in the correct order (7B-9)	R
	• Solve formulas for a given variable (10B-10)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Measurement	
	• Solve problems requiring the application of the Pythagorean theorem (10D-5)	R
	• Convert units of measure within a system (6D-9)	R
	Geometry	
	• Recognize properties and relationships of lines and of angles (10E-1)	R
	• Graph equations (10E-3)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
B19. Describe and identify filter networks (cont'd.)	Problem Solving	
	• Translate work phrases and sentences into algebraic expressions and equations (9G-1) • Follow a series of instructions in sequential order (8G-4)	R R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
B20. Test and evaluate filter performance	Understanding Numbers	
	• Use mathematical relationships to simplify expressions (10A-5)	R
	• Apply number theory concepts (9A-7)	R
	Computation	
	• Compute using scientific notation (9B-2)	R
	• Compute the sum, difference, product, or quotient of integers (8B-6)	R
	• Solve linear equations (10B-7)	R
	• Use operations in the correct order (7B-9)	R
	• Solve formulas for a given variable (10B-10)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Measurement	
	• Solve problems requiring the application of the Pythagorean theorem (10D-5)	R
	• Convert units of measure within a system (6D-9)	R
	Geometry	
	• Recognize properties and relationships of lines and of angles (10E-1)	R
	• Graph equations (10E-3)	R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
B20. Test and evaluate filter performance (cont'd.)	Graphing and Statistics Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R
	Follow a series of instructions in sequential order (8G-4)	R
C1. Describe types of transformers		
C2. Determine transformer requirements	Understanding Numbers Apply number theory concepts (9A-7)	R
	Computation Compute using scientific notation (9B-2)	R
	Solve formulas for a given variable (10B-10)	R
	Compute solutions of problems involving percents (7B-12)	R
	Problem Solving Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R
	Consumer Problems Solve problems using ratio and proportion in consumer situations (7H-4)	R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
C3. Determine rectifier (diode) specifications for specific installations	Computation • Compute using scientific notation (9B-2) • Solve linear equations (10B-7) • Solve formulas for a given variable (10B-10) • Compute solutions of problems involving percents (7B-12)	R R R R
	Problem Solving • Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R
C4. Select components for complete power supply	Computation • Compute using scientific notation (9B-2) • Solve linear equations (10B-7) • Solve formulas for a given variable (10B-10) • Compute solutions of problems involving percents (7B-12)	R R R R
	Problem Solving • Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
C5. Identify and describe use of series regulators	Computation	
	• Compute using scientific notation (9B-2)	R
	• Solve linear equations (10B-7)	R
	• Solve formulas for a given variable (10B-10)	R
	• Compute solutions of problems involving percents (7B-12)	R
C6. Identify and describe use of shunt regulators	Problem Solving	
	• Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R
	Computation	
	• Compute using scientific notation (9B-2)	R
	• Solve linear equations (10B-7)	R
	• Solve formulas for a given variable (10B-10)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Problem Solving	
	• Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
C7. Identify and describe use of switching regulators	Computation • Compute using scientific notation (9B-2) • Solve linear equations (10B-7) • Solve formulas for a given variable (10B-10) • Compute solutions of problems involving percents (7B-12) Problem Solving • Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R R R R R
C8. Install power supply components		
C9. Test power supply and correct defects	Computation • Compute using scientific notation (9B-2) • Solve linear equations (10B-7) • Solve formulas for a given variable (10B-10) • Compute solutions of problems involving percents (7B-12) Problem Solving • Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R R R R R
D1. Identify schematic design symbols for semiconductor devices		

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
D2. Describe the operation of junction diodes	Computation	
	• Compute using scientific notation (9B-2)	R
	• Solve linear equations (10B-7)	R
	• Solve formulas for a given variable (10B-10)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Measurement	
	• Convert units of measure within a system (6D-9)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
D3. Describe the operation of bipolar transistors	Understanding Numbers Use mathematical relationships to simplify expressions (10A-5)	R
	Computation Compute using scientific notation (9B-2)	R
	Solve linear equations (10B-7)	R
	Use operations in the correct order (7B-9)	R
	Solve formulas for a given variable (10B-10)	R
	Compute solutions of problems involving percents (7B-12)	R
	Graphing and Statistics Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
D4. Construct circuits using bipolar transistors	Computation	
	• Compute using scientific notation (9B-2)	R
	• Solve linear equations (10B-7)	R
	• Solve formulas for a given variable (10B-10)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Measurement	
	• Convert units of measure within a system (6D-9)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
D5. Describe the basic operation of a JFET	Computation	
	• Compute using scientific notation (9B-2)	R
	• Solve linear equations (10B-7)	R
	• Solve formulas for a given variable (10B-10)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Measurement	
	• Convert units of measure within a system (6D-9)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
D6. Describe the basic operation of a MOSFET	Computation	
	• Compute using scientific notation (9B-2)	R
	• Solve linear equations (10B-7)	R
	• Solve formulas for a given variable (10B-10)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Measurement	
	• Convert units of measure within a system (6D-9)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
D7. Describe the basic operation of a UJT	Computation	
	• Compute using scientific notation (9B-2)	R
	• Solve linear equations (10B-7)	R
	• Solve formulas for a given variable (10B-10)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Measurement	
	• Convert units of measure within a system (6D-9)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
D8. Describe the basic operation of a PUT	Computation • Compute using scientific notation (9B-2) • Solve linear equations (10B-7) • Solve formulas for a given variable (10B-10) • Compute solutions of problems involving percents (7B-12) Measurement • Convert units of measure within a system (6D-9) Graphing and Statistics • Construct, read, and interpret displays of data (7F-2) Problem Solving • Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R R R R R R R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
D9. Describe the basic operation of a DIAC	Computation	
	• Compute using scientific notation (9B-2)	R
	• Solve linear equations (10B-7)	R
	• Solve formulas for a given variable (10B-10)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Measurement	
	• Convert units of measure within a system (6D-9)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
D10. Describe the basic operation of an SCR	Computation	
	• Compute using scientific notation (9B-2)	R
	• Solve linear equations (10B-7)	R
	• Solve formulas for a given variable (10B-10)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Measurement	
	• Convert units of measure within a system (6D-9)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
D11. Describe the basic operation of a TRIAC	Computation	
	• Compute using scientific notation (9B-2)	R
	• Solve linear equations (10B-7)	R
	• Solve formulas for a given variable (10B-10)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Measurement	
	• Convert units of measure within a system (6D-9)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
D12. Describe the basic operation of a VDR	Computation	
	• Compute using scientific notation (9B-2)	R
	• Solve linear equations (10B-7)	R
	• Solve formulas for a given variable (10B-10)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Measurement	
	• Convert units of measure within a system (6D-9)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
D13. Test diodes	Computation	
	• Compute using scientific notation (9B-2)	R
	• Solve linear equations (10B-7)	R
	• Solve formulas for a given variable (10B-10)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Measurement	
	• Convert units of measure within a system (6D-9)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
D14. Test transistors	Computation	
	• Compute using scientific notation (9B-2)	R
	• Solve linear equations (10B-7)	R
	• Solve formulas for a given variable (10B-10)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Measurement	
	• Convert units of measure within a system (6D-9)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
D15. Test thyristors	Computation • Compute using scientific notation (9B-2) • Solve linear equations (10B-7) • Solve formulas for a given variable (10B-10) • Compute solutions of problems involving percents (7B-12) Measurement • Convert units of measure within a system (6D-9) Graphing and Statistics • Construct, read, and interpret displays of data (7F-2) Problem Solving • Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R R R R R R R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
D16. Select transistors for specific purposes using specification sheets and substitution guides	Computation	
	• Compute using scientific notation (9B-2)	R
	• Solve linear equations (10B-7)	R
	• Solve formulas for a given variable (10B-10)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Measurement	
	• Convert units of measure within a system (6D-9)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R
D17. Demonstrate the proper replacement techniques for semiconductor devices		

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
E1. Describe the operation of a bipolar amplifier	Computation	
	• Compute using scientific notation (9B-2)	R
	• Solve linear equations (10B-7)	R
	• Solve formulas for a given variable (10B-10)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Measurement	
	• Solve problems requiring the application of the Pythagorean theorem (10D-5)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R
	• Follow a series of instructions in sequential order (8G-4)	R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
E2. Describe the operation of an FET amplifier	Computation	
	• Compute using scientific notation (9B-2)	R
	• Solve linear equations (10B-7)	R
	• Solve formulas for a given variable (10B-10)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Measurement	
	• Solve problems requiring the application of the Pythagorean theorem (10D-5)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R
	• Follow a series of instructions in sequential order (8G-4)	R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
E3. Describe the operation of an operational amplifier	Computation	
	• Compute using scientific notation (9B-2)	R
	• Solve linear equations (10B-7)	R
	• Solve formulas for a given variable (10B-10)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Measurement	
	• Solve problems requiring the application of the Pythagorean theorem (10D-5)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R
	• Follow a series of instructions in sequential order (8G-4)	R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
E4. Test and repair bipolar amplifier	Computation	
	• Compute using scientific notation (9B-2)	R
	• Solve linear equations (10B-7)	R
	• Solve formulas for a given variable (10B-10)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Measurement	
	• Solve problems requiring the application of the Pythagorean theorem (10D-5)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R
	• Follow a series of instructions in sequential order (8G-4)	R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
E5. Test and repair FET amplifier	Computation	
	• Compute using scientific notation (9B-2)	R
	• Solve linear equations (10B-7)	R
	• Solve formulas for a given variable (10B-10)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Measurement	
	• Solve problems requiring the application of the Pythagorean theorem (10D-5)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R
	• Follow a series of instructions in sequential order (8G-4)	R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
E6. Test and repair operational amplifier	Computation	
	• Compute using scientific notation (9B-2)	R
	• Solve linear equations (10B-7)	R
	• Solve formulas for a given variable (10B-10)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Measurement	
	• Solve problems requiring the application of the Pythagorean theorem (10D-5)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R
	• Follow a series of instructions in sequential order (8G-4)	R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
E7. Describe amplifier coupling techniques	Understanding Numbers	
	• Apply number theory concepts (9A-7)	R
	Computation	
	• Compute using scientific notation (9B-2)	R
	• Solve formulas for a given variable (10B-10)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Measurement	
	• Solve problems requiring the application of the Pythagorean theorem (10D-5)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R
	• Follow a series of instructions in sequential order (8G-4)	R
	Consumer Problems	
	• Solve problems using ratio and proportion in consumer situations (7H-4)	R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
E8. Measure frequency response of amplifiers	Understanding Numbers	
	• Apply number theory concepts (9A-7)	R
	Computation	
	• Compute using scientific notation (9B-2)	R
	• Solve formulas for a given variable (10B-10)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Measurement	
	• Solve problems requiring the application of the Pythagorean theorem (10D-5)	R
	• Convert units of measure within a system (6D-9)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R
	• Follow a series of instructions in sequential order (8G-4)	R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
F1. Describe the basic operation of oscillators	Understanding Numbers	
	• Apply number theory concepts (9A-7)	R
	Computation	
	• Compute using scientific notation (9B-2)	R
	• Solve formulas for a given variable (10B-10)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Measurement	
	• Solve problems requiring the application of the Pythagorean theorem (10D-5)	R
	• Convert units of measure within a system (6D-9)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R
	• Follow a series of instructions in sequential order (8G-4)	R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
F2. Describe the basic operation of a crystal oscillator	Understanding Numbers	
	• Apply number theory concepts (9A-7)	R
	Computation	
	• Compute using scientific notation (9B-2)	R
	• Solve formulas for a given variable (10B-10)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Measurement	
	• Solve problems requiring the application of the Pythagorean theorem (10D-5)	R
	• Convert units of measure within a system (6D-9)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R
	• Follow a series of instructions in sequential order (8G-4)	R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
F3. Describe operation of phase lock loop (PLL)	Understanding Numbers	R
	• Use mathematical relationships to simplify expressions (10A-5)	
	Computation	R
	• Compute using scientific notation (9B-2)	
	• Solve linear equations (10B-7)	R
	• Solve formulas for a given variable (10B-10)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Measurement	
	• Solve problems requiring the application of the Pythagorean theorem (10D-5)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R
	• Follow a series of instructions in sequential order (8G-4)	R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
F4. Describe operation of waveform generators	Understanding Numbers Use mathematical relationships to simplify expressions (10A-5)	R
	Computation Compute using scientific notation (9B-2)	R
	Solve linear equations (10B-7)	R
	Solve formulas for a given variable (10B-10)	R
	Compute solutions of problems involving percents (7B-12)	R
	Measurement Solve problems requiring the application of the Pythagorean theorem (10D-5)	R
	Graphing and Statistics Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R
	Follow a series of instructions in sequential order (8G-4)	R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
F5. Test and repair oscillators	Understanding Numbers Use mathematical relationships to simplify expressions (10A-5)	R
	Computation Compute using scientific notation (9B-2)	R
	Solve linear equations (10B-7)	R
	Solve formulas for a given variable (10B-10)	R
	Compute solutions of problems involving percents (7B-12)	R
	Measurement Solve problems requiring the application of the Pythagorean theorem (10D-5)	R
	Graphing and Statistics Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving - Translate work phrases and sentences into algebraic expressions and equations (9G-1) - Follow a series of instructions in sequential order (8G-4)	R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
F6. Test and repair phase lock loop (PLL)	Understanding Numbers Use mathematical relationships to simplify expressions (10A-5)	R
	Computation Compute using scientific notation (9B-2)	R
	Solve linear equations (10B-7)	R
	Solve formulas for a given variable (10B-10)	R
	Compute solutions of problems involving percents (7B-12)	R
	Measurement Solve problems requiring the application of the Pythagorean theorem (10D-5)	R
	Graphing and Statistics Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving - Translate work phrases and sentences into algebraic expressions and equations (9G-1) - Follow a series of instructions in sequential order (8G-4)	R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
F7. Test and repair waveform generators	Understanding Numbers • Use mathematical relationships to simplify expressions (10A-5)	R
	Computation • Compute using scientific notation (9B-2)	R
	• Solve linear equations (10B-7)	R
	• Solve formulas for a given variable (10B-10)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Measurement • Solve problems requiring the application of the Pythagorean theorem (10D-5)	R
	Graphing and Statistics • Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving • Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R
	• Follow a series of instructions in sequential order (8G-4)	R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
G1. Identify and describe the stages of a radio receiver, AM/FM	Understanding Numbers • Use mathematical relationships to simplify expressions (10A-5)	R
	Computation • Compute using scientific notation (9B-2)	R
	• Solve linear equations (10B-7)	R
	• Use operations in the correct order (7B-9)	R
	• Solve formulas for a given variable (10B-10)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Measurement • Solve problems requiring the application of the Pythagorean theorem (10D-5)	R
	• Convert units of measure within a system (6D-9)	R
	Graphing and Statistics • Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving • Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R
	• Follow a series of instructions in sequential order (8G-4)	R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
G2. Identify and describe the stages of a radio transmitter, AM/FM	Understanding Numbers	
	• Use mathematical relationships to simplify expressions (10A-5)	R
	Computation	
	• Compute using scientific notation (9B-2)	R
	• Solve linear equations (10B-7)	R
	• Use operations in the correct order (7B-9)	R
	• Solve formulas for a given variable (10B-10)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Measurement	
	• Solve problems requiring the application of the Pythagorean theorem (10D-5)	R
	• Convert units of measure within a system (6D-9)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R
	• Follow a series of instructions in sequential order (8G-4)	R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
G3. Describe the basic operation of microwave and satellite transmitter/receiver systems	Understanding Numbers Use mathematical relationships to simplify expressions (10A-5)	R
	Computation Compute using scientific notation (9B-2)	R
	Solve linear equations (10B-7)	R
	Use operations in the correct order (7B-9)	R
	Solve formulas for a given variable (10B-10)	R
	Compute solutions of problems involving percents (7B-12)	R
	Measurement Solve problems requiring the application of the Pythagorean theorem (10D-5)	R
	Convert units of measure within a system (6D-9)	R
	Graphing and Statistics Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R
	Follow a series of instructions in sequential order (8G-4)	R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
G4. Describe the operation of transmitter/receiver antennae	Understanding Numbers	
	• Use mathematical relationships to simplify expressions (10A-5)	R
	Computation	
	• Compute using scientific notation (9B-2)	R
	• Solve linear equations (10B-7)	R
	• Use operations in the correct order (7B-9)	R
	• Solve formulas for a given variable (10B-10)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Measurement	
	• Solve problems requiring the application of the Pythagorean theorem (10D-5)	R
	• Convert units of measure within a system (6D-9)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R
	• Follow a series of instructions in sequential order (8G-4)	R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
H1. Describe the operation and demonstrate the use of an oscilloscope	Understanding Numbers	
	• Use mathematical relationships to simplify expressions (10A-5)	R
	Computation	
	• Compute using scientific notation (9B-2)	R
	• Solve linear equations (10B-7)	R
	• Use operations in the correct order (7B-9)	R
	• Solve formulas for a given variable (10B-10)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Measurement	
	• Solve problems requiring the application of the Pythagorean theorem (10D-5)	R
	• Convert units of measure within a system (6D-9)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R
	• Follow a series of instructions in sequential order (8G-4)	R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
H2. Describe the operation and demonstrate the use of multimeters; i.e., VOM, EVM or DVM	Understanding Numbers	
	• Use mathematical relationships to simplify expressions (10A-5)	R
	Computation	
	• Compute using scientific notation (9B-2)	R
	• Solve linear equations (10B-7)	R
	• Use operations in the correct order (7B-9)	R
	• Solve formulas for a given variable (10B-10)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Measurement	
	• Solve problems requiring the application of the Pythagorean theorem (10D-5)	R
	• Convert units of measure within a system (6D-9)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R
	• Follow a series of instructions in sequential order (8G-4)	R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
H3. Describe the operation and demonstrate the use of signal generators; i.e., audio, RF or function	Understanding Numbers	
	• Use mathematical relationships to simplify expressions (10A-5)	R
	Computation	
	• Compute using scientific notation (9B-2)	R
	• Solve linear equations (10B-7)	R
	• Use operations in the correct order (7B-9)	R
	• Solve formulas for a given variable (10B-10)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Measurement	
	• Solve problems requiring the application of the Pythagorean theorem (10D-5)	R
	• Convert units of measure within a system (6D-9)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R
	• Follow a series of instructions in sequential order (8G-4)	R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
H4. Describe the operation and demonstrate the use of a frequency counter	Understanding Numbers	
	• Use mathematical relationships to simplify expressions (10A-5)	R
	Computation	
	• Compute using scientific notation (9B-2)	R
	• Solve linear equations (10B-7)	R
	• Use operations in the correct order (7B-9)	R
	• Solve formulas for a given variable (10B-10)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Measurement	
	• Solve problems requiring the application of the Pythagorean theorem (10D-5)	R
	• Convert units of measure within a system (6D-9)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R
	• Follow a series of instructions in sequential order (8G-4)	R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
H5. Describe the function and application of analyzers; i.e., Signature, Data, LOGS, Spectrum or Components	Understanding Numbers	
	• Use mathematical relationships to simplify expressions (10A-5)	R
	Computation	
	• Compute using scientific notation (9B-2)	R
	• Solve linear equations (10B-7)	R
	• Use operations in the correct order (7B-9)	R
	• Solve formulas for a given variable (10B-10)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Measurement	
	• Solve problems requiring the application of the Pythagorean theorem (10D-5)	R
	• Convert units of measure within a system (6D-9)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R
	• Follow a series of instructions in sequential order (8G-4)	R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
H6. Describe the operation and demonstrate the use of logic probes	Understanding Numbers	
	• Use mathematical relationships to simplify expressions (10A-5)	R
	Computation	
	• Compute using scientific notation (9B-2)	R
	• Solve linear equations (10B-7)	R
	• Use operations in the correct order (7B-9)	R
	• Solve formulas for a given variable (10B-10)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Measurement	
	• Solve problems requiring the application of the Pythagorean theorem (10D-5)	R
	• Convert units of measure within a system (6D-9)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R
	• Follow a series of instructions in sequential order (8G-4)	R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
H7. Describe the operation and demonstrate the use of digital breakout boxes	Understanding Numbers	
	• Use mathematical relationships to simplify expressions (10A-5)	R
	Computation	
	• Compute using scientific notation (9B-2)	R
	• Solve linear equations (10B-7)	R
	• Use operations in the correct order (7B-9)	R
	• Solve formulas for a given variable (10B-10)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Measurement	
	• Solve problems requiring the application of the Pythagorean theorem (10D-5)	R
	• Convert units of measure within a system (6D-9)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R
	• Follow a series of instructions in sequential order (8G-4)	R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
H8. Describe the operation and demonstrate the use of analog breakout boxes	Understanding Numbers Use mathematical relationships to simplify expressions (10A-5)	R
	Computation Compute using scientific notation (9B-2)	R
	Solve linear equations (10B-7)	R
	Use operations in the correct order (7B-9)	R
	Solve formulas for a given variable (10B-10)	R
	Compute solutions of problems involving percents (7B-12)	R
	Measurement Solve problems requiring the application of the Pythagorean theorem (10D-5)	R
	Convert units of measure within a system (6D-9)	R
	Graphing and Statistics Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R
	Follow a series of instructions in sequential order (8G-4)	R
I1. Identify and describe computer architecture		
I2. Identify the levels of computer languages		

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
17. Describe interfacing techniques	Understanding Numbers	R
	• Communicate and interpret numbers (8A-1)	
	Computation	R
	• Compute using scientific notation (9B-2)	
	Measurement	R
	• Convert units of measure within a system (6D-9)	
18. Explain control and data transfer techniques to and from peripheral devices	Understanding Numbers	R
	• Communicate and interpret numbers (8A-1)	
	Computation	R
	• Compute using scientific notation (9B-2)	
	Measurement	R
	• Convert units of measure within a system (6D-9)	
19. Troubleshoot hardware problems	Understanding Numbers	R
	• Communicate and interpret numbers (8A-1)	
	Computation	R
	• Compute using scientific notation (9B-2)	
	Measurement	R
	• Convert units of measure within a system (6D-9)	
J1. Describe physical aspects of light		
J2. Identify types of photodetectors and emitters		
J3. Construct a circuit using a photodetector and emitter		

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
J4. Describe optically coupled electronic systems	Computation • Compute using scientific notation (9B-2) • Solve linear equations (10B-7) • Solve formulas for a given variable (10B-10) • Compute solutions of problems involving percents (7B-12) Graphing and Statistics • Construct, read, and interpret displays of data (7F-2) Problem Solving • Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R R R R R R
J5. Describe optoelectronic methods of communication	Computation • Compute using scientific notation (9B-2) • Solve linear equations (10B-7) • Solve formulas for a given variable (10B-10) • Compute solutions of problems involving percents (7B-12) Graphing and Statistics • Construct, read, and interpret displays of data (7F-2) Problem Solving • Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R R R R R R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
K3. Develop truth tables defining circuit design	Understanding Numbers Communicate and interpret numbers (8A-1)	R
	Measurement Convert units of measure within a system (6D-9)	R
K4. Test and repair logic circuits	Understanding Numbers Communicate and interpret numbers (8A-1)	R
	Use mathematical relationships to simplify expressions (10A-5)	R
	Computation Compute using scientific notation (9B-2)	R
	Solve linear equations (10B-7)	R
	Use operations in the correct order (7B-9)	R
	Solve formulas for a given variable (10B-10)	R
	Compute solutions of problems involving percents (7B-12)	R
	Measurement Convert units of measure within a system (6D-9)	R
	Graphing and Statistics Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R
K5. List advantages and disadvantages of SSI, MSI, LSI and VLSI		

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
K6. Describe the characteristics of ROM's and PLA's	Understanding Numbers Communicate and interpret numbers (8A-1)	R
	Measurement Convert units of measure within a system (6D-9)	R
K7. Construct combination logic circuits for a given application	Understanding Numbers Communicate and interpret numbers (8A-1)	R
	Use mathematical relationships to simplify expressions (10A-5)	R
	Computation Compute using scientific notation (9B-2)	R
	Use operations in the correct order (7B-9)	R
	Solve linear equations (10B-7)	R
	Solve formulas for a given variable (10B-10)	R
	Compute solutions of problems involving percents (7B-12)	R
	Measurement Convert units of measure within a system (6D-9)	R
	Graphing and Statistics Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
K8. Describe digital counter operating modes and their function	Understanding Numbers Communicate and interpret numbers (8A-1)	R
	Measurement Convert units of measure within a system (6D-9)	R
K9. Construct counter and controller circuits for sequential logic applications	Understanding Numbers Communicate and interpret numbers (8A-1)	R
	Use mathematical relationships to simplify expressions (10A-5)	R
	Computation Compute using scientific notation (9B-2)	R
	Solve linear equations (10B-7)	R
	Use operations in the correct order (7B-9)	R
	Solve formulas for a given variable (10B-10)	R
	Compute solutions of problems involving percents (7B-12)	R
	Measurement Convert units of measure within a system (6D-9)	R
	Graphing and Statistics Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
K10. Describe the advantages of test instruments that use digital techniques	Understanding Numbers	R
	- Communicate and interpret numbers (8A-1) Measurement - Convert units of measure within a system (6D-9)	R
K11. Use data sheets	Understanding Numbers	R
	- Communicate and interpret numbers (8A-1) Measurement - Convert units of measure within a system (6D-9)	R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
K12. Describe the operation of A/D and D/A converters	Understanding Numbers	
	• Communicate and interpret numbers (8A-1)	R
	• Use mathematical relationships to simplify expressions (10A-5)	R
	Computation	
	• Compute using scientific notation (9B-2)	R
	• Solve linear equations (10B-7)	R
	• Use operations in the correct order (7B-9)	R
	• Solve formulas for a given variable (10B-10)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Measurement	
	• Convert units of measure within a system (6D-9)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
L1. Test and repair a DC motor	Understanding Numbers	
	• Use mathematical relationships to simplify expressions (10A-5)	R
	Computation	
	• Compute using scientific notation (9B-2)	R
	• Solve linear equations (10B-7)	R
	• Use operations in the correct order (7B-9)	R
	• Solve formulas for a given variable (10B-10)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Measurement	
	• Convert units of measure within a system (6D-9)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
L2. Test and repair an AC motor (single and polyphase)	Understanding Numbers Use mathematical relationships to simplify expressions (10A-5)	R
	Computation Compute using scientific notation (9B-2)	R
	Solve linear equations (10B-7)	R
	Use operations in the correct order (7B-9)	R
	Solve formulas for a given variable (10B-10)	R
	Compute solutions of problems involving percents (7B-12)	R
	Measurement Convert units of measure within a system (6D-9)	R
	Graphing and Statistics Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
L3. Test and repair a stepper motor	Understanding Numbers • Use mathematical relationships to simplify expressions (10A-5) Computation • Compute using scientific notation (9B-2) • Solve linear equations (10B-7) • Use operations in the correct order (7B-9) • Solve formulas for a given variable (10B-10) • Compute solutions of problems involving percents (7B-12) Measurement • Convert units of measure within a system (6D-9) Graphing and Statistics • Construct, read, and interpret displays of data (7F-2) Problem Solving • Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R R R R R R R R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
L4. Test and repair electromechanical control devices	Understanding Numbers Use mathematical relationships to simplify expressions (10A-5)	R
	Computation Compute using scientific notation (9B-2)	R
	Solve linear equations (10B-7)	R
	Use operations in the correct order (7B-9)	R
	Solve formulas for a given variable (10B-10)	R
	Compute solutions of problems involving percents (7B-12)	R
	Measurement Convert units of measure within a system (6D-9)	R
	Graphing and Statistics Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
L5. Test and repair analog electronic control devices	Understanding Numbers • Use mathematical relationships to simplify expressions (10A-5)	R
	Computation • Compute using scientific notation (9B-2)	R
	• Solve linear equations (10B-7)	R
	• Use operations in the correct order (7B-9)	R
	• Solve formulas for a given variable (10B-10)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Measurement • Convert units of measure within a system (6D-9)	R
	Graphing and Statistics • Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving • Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
L6. Test and repair digital electronic control devices	Understanding Numbers	
	• Communicate and interpret numbers (8A-1)	R
	• Use mathematical relationships to simplify expressions (10A-5)	R
	Computation	
	• Compute using scientific notation (9B-2)	R
	• Solve linear equations (10B-7)	R
	• Use operations in the correct order (7B-9)	R
	• Solve formulas for a given variable (10B-10)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Measurement	
	• Convert units of measure within a system (6D-9)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R
L7. Explain the proper connection of Delta and Wye motor connections		

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
L8. Describe the operation of motor speed control	Understanding Numbers	
	• Use mathematical relationships to simplify expressions (10A-5)	R
	Computation	
	• Compute using scientific notation (9B-2)	R
	• Solve linear equations (10B-7)	R
	• Use operations in the correct order (7B-9)	R
	• Solve formulas for a given variable (10B-10)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Measurement	
	• Convert units of measure within a system (6D-9)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
L9. Describe the operation of programmable controllers	Understanding Numbers - Communicate and interpret numbers (8A-1) - Use mathematical relationships to simplify expressions (10A-5) Computation - Compute using scientific notation (9B-2) - Solve linear equations (10B-7) - Use operations in the correct order (7B-9) - Solve formulas for a given variable (10B-10) - Compute solutions of problems involving percents (7B-12) Measurement - Convert units of measure within a system (6D-9) Graphing and Statistics - Construct, read, and interpret displays of data (7F-2) Problem Solving - Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R R R R R R R R
M1. Breadboard circuits		
M2. Wirewrap circuits		
M3. Solder/desolder circuits		
M4. Select and install proper components for specific use		
M5. Repair printed circuit boards		

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
N1. Describe system operation using block diagram	Understanding Numbers	
	• Communicate and interpret numbers (8A-1)	R
	• Use mathematical relationships to simplify expressions (10A-5)	R
	Computation	
	• Compute using scientific notation (9B-2)	R
	• Solve linear equations (10B-7)	R
	• Use operations in the correct order (7B-9)	R
	• Solve formulas for a given variable (10B-10)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Measurement	
	• Convert units of measure within a system (6D-9)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
N2. Identify problem area by symptom	Understanding Numbers	
	• Communicate and interpret numbers (8A-1)	R
	• Use mathematical relationships to simplify expressions (10A-5)	R
	Computation	
	• Compute using scientific notation (9B-2)	R
	• Solve linear equations (10B-7)	R
	• Use operations in the correct order (7B-9)	R
	• Solve formulas for a given variable (10B-10)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Measurement	
	• Convert units of measure within a system (6D-9)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
N3. Diagnose by signal tracing and/or injecting	Understanding Numbers	
	• Communicate and interpret numbers (8A-1)	R
	• Use mathematical relationships to simplify expressions (10A-5)	R
	Computation	
	• Compute using scientific notation (9B-2)	R
	• Solve linear equations (10B-7)	R
	• Use operations in the correct order (7B-9)	R
	• Solve formulas for a given variable (10B-10)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Measurement	
	• Convert units of measure within a system (6D-9)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
N4. Isolate defective unit, circuit and components	Understanding Numbers	
	• Communicate and interpret numbers (8A-1)	R
	• Use mathematical relationships to simplify expressions (10A-5)	R
	Computation	
	• Compute using scientific notation (9B-2)	R
	• Solve linear equations (10B-7)	R
	• Use operations in the correct order (7B-9)	R
	• Solve formulas for a given variable (10B-10)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Measurement	
	• Convert units of measure within a system (6D-9)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R

ELECTRONICS		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
N5. Test for proper operation after repair	Understanding Numbers	
	• Communicate and interpret numbers (8A-1)	R
	• Use mathematical relationships to simplify expressions (10A-5)	R
	Computation	
	• Compute using scientific notation (9B-2)	R
	• Solve linear equations (10B-7)	R
	• Use operations in the correct order (7B-9)	R
	• Solve formulas for a given variable (10B-10)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Measurement	
	• Convert units of measure within a system (6D-9)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Translate work phrases and sentences into algebraic expressions and equations (9G-1)	R

APPENDIX:
Additional Math Skills Information

**Based on
1990 Core Competencies And Key Skills
For Missouri Schools**

**Mathematics
Grade 2-10**

GRADE LEVEL 2	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
2	2 Compare whole numbers 3 Identify place value a the digit in the ones', tens', or hundreds' place b the place value of a given digit by name c the value of a digit in the ones', tens', or hundreds' place 4 Complete and create patterns a number b geometric c graphic 6 Identify fractional parts	2 Add whole numbers 3 Subtract whole numbers 7 Explore the use of open sentences to describe mathematical relationships a involving addition b involving subtraction c which represent given computational situations		3 Tell and record time	1 Describe, model, draw, and classify shapes a rectangles and squares b circles c triangles	2 Construct, read, and interpret displays of data a bar graphs b pictographs c other displays of data		2 Solve word problems involving addition 3 Solve word problems involving subtraction

GRADE LEVEL 3	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
3	2 Compare numbers a compare two numbers using < or > b order a set of numbers by magnitude 3 Identify place value a the digit in the ones', tens', hundreds', or thousands' place b the place value of a given digit by name c the value of a digit in the ones', tens', hundreds', or thousands' place 6 Identify fractional parts	4 Add and subtract whole numbers with regrouping 5 Multiply whole numbers 7 Explore the use of open sentences to describe mathematical relationships a involving addition b involving subtraction c involving multiplication and division d identify open sentences that represent given computational situations		3 Tell and record time a relate various recording conventions to each other 5 Measure length, weight (mass), volume, and capacity using nonstandard and standard units a nearest inch b nearest centimeter c nearest pound or kilogram d nearest cup, pint, quart, gallon, and liter	2 Identify cones, cylinders, spheres, pyramids, and cubes	2 Construct, read, and interpret displays of data a read bar graphs and pictographs b contrast displays of data c interpret displays of data 3 Locate points on a grid		2 Solve word problems involving addition and subtraction of money 4 Solve word problems using addition, subtraction, and multiplication

GRADE LEVEL 4	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
4	3 Identify place value a the digit in the ones', tens', hundreds', thousands', or ten thousands' place b the place value of a given digit by name through ten thousands c the value of a specified digit(s) through the ten thousands' place 6 Graph points representing fractions on a number line a select the fraction represented by a given point on a number line b select the point on a number line representing a given fraction	4 Add and subtract whole numbers with up to four addends 5 Multiply whole numbers (3-digit by 1-digit) 7 Use open sentences to express mathematical relationships a identify the open sentence which represents a computational situation involving addition and/or subtraction, and multiplication and/or division b identify the computational situation which represents an open sentence involving addition and/or subtraction and multiplication and/or division	3 Recognize a situation in which an estimate or an exact answer is appropriate	2 Estimate measurements including area and perimeter of regular and irregular regions 5 Measure lengths a to the nearest half inch b to the nearest centimeter	2 Explore properties of right angles	2 Construct, read, and interpret displays of data a select bar graphs and pictographs b contrast displays of data		2 Solve problems involving money management a with computational algorithms b which may require nonstandard strategies 4 Solve standard multi-step word problems, using one or more than one operation 5 Solve nonstandard word problems

GRADE LEVEL 5	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
5	2 Compare unit fractions a compare two fractions using < or > b order a set of fractions by magnitude 3 Compare decimals a compare two decimals using <, >, or = b order a set of decimals by magnitude 7 Apply number theory concepts a factors b multiples	5 Multiply and divide whole numbers (3-digit by 2-digit) 7 Solve number sentences a involving addition and subtraction with whole numbers and/or decimals b involving multiplication and division with whole numbers with 1-digit multipliers and divisors 8 Add and subtract like fractions	2 Use estimation strategies and mental computation to determine whether an answer is reasonable	2 Estimate measurements a linear measure b area, mass, and volume measures 6 Measure area and perimeter of regular and irregular regions using nonstandard and standard units 9 Convert units of measure within a system a metric system b English system	1 Identify properties of lines a intersecting, parallel, and perpendicular lines b vertical, horizontal, and diagonal (oblique) lines 4 Compare and classify geometric shapes and solids a similar figures b congruent figures c identify a figure with a specified number of lines of symmetry d regular polygons e right triangles	1 Systematically collect, organize, and describe data a best method for collecting data b accurate organization of given data c describe data using ratio and proportion 2 Construct, read, and interpret displays of data a identify graphs that accurately represent given data b interpret displays of data c construct displays of data		4 Solve standard multi-step word problems 5 Solve nonstandard word problems

GRADE LEVEL 6	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
6	2 Compare fractions and decimals a compare two fractions using $<$, $>$, or $=$ b compare two decimals using $<$, $>$, or $=$ c order a set of fractions or decimals by magnitude 4 Compare a numerical sequence 6 Graph points representing positive rational numbers on a number line a select the fraction or decimal represented by a given point b select the point representing a given fraction or decimal	6 Add, subtract, multiply, and divide whole numbers 7 Solve number sentences a involving whole numbers and decimals b involving whole numbers and like fractions 8 Multiply fractions a whole numbers and fractions b fractions with denominators less than 10 9 Use operations in the correct order		1 Choose an appropriate unit of measure and the corresponding tool for a given situation a within the metric system b within the English system 6 Calculate areas and perimeters a of squares and rectangles 9 Convert units of measure within a system a metric system b English system	4 Compare and classify geometric shapes and solids a similar figures b congruent figures c identify a figure with a specified number of lines of symmetry d regular polygons e right triangles	1 Systematically collect, organize, and describe data a best method for collecting data b accurate organization of given data 2 Construct, read, and interpret displays of data a identify graphs that accurately represent given data b interpret displays of data c construct displays of data		1 Solve word problems involving money 4 Solve standard multi-step word problems 5 Solve nonstandard word problems

GRADE LEVEL 7	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
7	1 Communicate and interpret numbers a interpret calculator displays b express numbers in scientific notation with positive exponents c express large numbers in conventional notation 2 Compare positive rational numbers a compare fraction to fraction b compare decimal to fraction 5 Use numerical relationships to describe and simplify numerical situations 7 Apply number theory concepts a classify numbers as prime or composite b factors c multiples d multiple classifications	1 Recall fraction/decimal/percent equivalents 7 Solve linear equations (number sentences) a one-step b two-step 8 Compute the sum, difference, product, or quotient of fractions 9 Use operations in correct order a with + and/or - and + b with + and/or - and x 12 Compute solutions of problems involving percents a calculate percent of a number b calculate percent one number is of another c calculate the whole when a percent is given	1 Determine a reasonable estimate 2 Use estimation strategies and mental computation to determine if an answer is reasonable 5 Solve problems utilizing estimation a utilizing percents b utilizing fractions c utilizing decimals	1 Choose the appropriate unit of precision for a given measurement situation a in metric measurements b in standard measurements 2 Estimate measurement 6 Approximate and/or calculate areas and perimeters of irregularly shaped regions 10 Investigate the relationships among circumference, area, and diameter of a circle 11 Solve problems involving measurement	1 Recognize properties and relationships of lines and angles 2 Classify polygons a classify regular polygons with five or more sides b classify irregular polygons with five or more sides c classify quadrilaterals 3 Determine lines of symmetry in natural and geometric figures a in a natural figure b in a plane geometric figure 5 Identify the plane geometric figures which form the surfaces of three dimensional projects	1 Systematically collect, organize, and classify data a collect and organize statistical data b describe the most appropriate measure c determine mean d determine median e determine mode f determine range 2 Construct, read, and interpret displays of data a construct graphic data displays b identify correctly constructed bar and line graphs, pie charts, pictographs, and scattergrams c interpret bar and line graphs, pie charts, pictographs, and scattergrams 3 Formulate and solve problems that involve collecting and analyzing data	1 Create a problem to illustrate a given numerical sentence 2 Write a number sentence to illustrate a problem 3 Identify unnecessary or missing numerical data in a word problem	2 Solve problems involving percent in consumer situations a sales tax b discount c commission 4 Solve problems using ratio and proportion in consumer situations a involving pricing b involving recipe conversion c involving medication dosage d involving relative distances between locations

GRADE LEVEL 8	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
8	1 Communicate and interpret numbers a convert rational numbers to scientific notation b convert scientific notation to rational numbers 2 Compare rational numbers a compare fraction to fraction b compare decimal to fraction 5 Use mathematical relationships to describe and simplify mathematical expressions 7 Apply number theory a determine powers b determine square roots c determine cube roots	6 Compute the sum, difference, product, or quotient of integers 7 Solve linear equations a one-step b two-step 9 Evaluate algebraic expressions, given values for the variables	2 Use estimation strategies and mental computation to determine if an answer is reasonable 5 Solve problems utilizing estimation a utilizing percents b utilizing fractions c utilizing decimals	2 Estimate measurement 6 Calculate the perimeter or the area of a triangle, rectangle, or square 10 Calculate the circumference or the area of a circle 11 Solve problems involving measurement	1 Recognize properties and relationships of lines and angles a identify bisectors b identify radii c identify diagonals d identify diameters e identify interior angles f identify exterior angles 2 Classify polygons a classify triangles by sides/angles b classify quadrilaterals (e.g., parallelogram, rectangle, rhombus, trapezoid) 3 Recognize similar and congruent figures 5 Visualize, draw, and construct geometric figures	3 Formulate and solve problems that involve collecting and analyzing data 4 Calculate and interpret the probability of an event	1 Create a word problem to illustrate a given equation, or write an equation to illustrate a given problem 4 Follow a series of instructions in sequential order a in a flow chart b in a diagram c in a narrative	1 Solve problems involving money in consumer situations a involving simple interest b involving total cost of installment purchases c involving total cost of purchases including sales tax d involving discounts e involving sale prices 3 Solve problems involving area and perimeter in consumer situations 4 Solve problems using proportion in consumer situations a involving pricing b involving recipe conversion c involving medication dosage d involving relative distances between locations

GRADE LEVEL 9	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
9	5 Use mathematical relationships to simplify expressions a mathematical expressions b algebraic expressions 7 Apply number theory concepts	2 Compute using scientific notation 7 Solve linear equations a one/two steps with integral coefficients and integral or rational solutions	2 Judge reasonableness of solutions or estimates of solutions to problems 4 Determine the relative magnitude of fractional numbers 5 Solve problems utilizing estimation a consumer situations b practical situations	5 Compute the area and perimeter of irregularly shaped figures 11 Solve problems involving measurement a volume of cylinders b volume of rectangular solids	1 Recognize properties and relationships of lines and angles 4 Determine if a given point is on the graph of a given equation 5 Visualize, draw, and construct geometric figures 6 Solve problems using measures of inclination: (slope)	2 Calculate and interpret the probability of an event 3 Formulate and solve problems that involve collecting and analyzing statistical data a draw inferences b evaluate conclusions c solve problems involving mean, median, mode, and range 4 Judge the reliability of inferences drawn from statistical data	1 Translate word phrases and sentences into algebraic expressions and equations 2 Evaluate the validity of conclusions drawn from given premises and definitions 3 Identify impediments to solving a given problem a information to solve a problem b information missing to solve a problem c information unnecessary to solve a problem d information that needs to be converted to another form	1 Solve problems involving volume and area in consumer situations 2 Solve problems using proportion in consumer situations a involving pricing b involving food, recipes, and nutrition c involving medication dosage d involving relative distances between locations 3 Investigate problems involving personal finance 4 Compute gross pay using hourly, monthly, commission, piecework, and/or overtime rates

GRADE LEVEL 10	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
10	5 Use mathematical relationships to simplify expressions a mathematical expressions b algebraic expressions	7 Solve linear equations a with decimal coefficients b with fractional coefficients c with integral coefficients 10 Solve formulas for a given variable	1 Estimate solutions for various computational problems a using scientific notation b using whole numbers c using fractions d using decimals 2 Judge reasonableness of solutions 5 Solve problems utilizing estimation a on consumer situations b on practical situations	5 Solve problems requiring the application of the Pythagorean theorem a given diagrams and measurements of right triangles b given a situation involving a right triangle 11 Solve problems involving measurement	1 Recognize properties and relationships of lines and angles a parallel and perpendicular lines b complementary and supplementary angles c alternate interior and corresponding angles d calculate the third angle of a triangle 3 Graph equations a plot the graph of a linear equation b identify the graph of a linear equation c identify the slope of a line given its graph and equation d use the graph of a line to identify its equation 5 Visualize, draw, and construct geometric figures 6 Solve problems using the concepts of symmetry, similarity, and congruence a determine lines of symmetry b use the concept of congruence	2 Calculate and interpret the probability of an event 3 Identify limitations of an inference drawn from statistical data a limitations to an inference b additional information needed c demonstrable bias	1 State logical conclusions from given conditions 2 Evaluate the acceptability of a conclusion drawn through logical inference	2 Solve banking problems related to maintaining a checking account 4 Use appropriate information and tables to compute net pay, considering Social Security deductions, state and federal taxes, etc.

INTEGRATING VOCATIONAL COMPETENCIES AND MATH SKILLS

GRAPHIC ARTS

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FOREWORD

National interest and legislation support the need for identifying core competencies and key skills taught in industrial education classes. An understanding of the basic competencies involved will help identify academic subjects as they relate to specific occupations.

The following program area/math skills matrix can therefore be a valuable resource for program integration of academics, pre-testing and skills assessment, and special needs curriculum development. It identifies the math core competencies and key skills required for/taught in one of ten program areas at the Missouri secondary level. Matrices were developed for: Air Conditioning, Heating, and Refrigeration; Auto Collision Technology; Automotive Technology; Building Trades; Drafting; Electronics; Graphic Arts (Offset Lithography); Health Services Assistant; Machine Technology; and Welding.

The materials used to create the matrix include: the 1990 Core Competencies and Key Skills for Missouri Schools, grades two through ten; and Instructional Materials Laboratory vocational program competency profiles for the program areas involved.

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TO THE INSTRUCTOR: SUGGESTIONS FOR USE

The matrix that follows is divided into three columns. Reading in a row across all three of the columns will identify which math skills are involved in each vocational competency and tell whether the math skills are new to students or simply need reinforcement.

The first column identifies the vocational competencies involved in the program area. The numbers and competencies in this column refer to the Instructional Materials Laboratory competency profile for the program area.

The second column identifies which math skills are involved in the vocational competencies. The skills and numbers listed in this column refer to the 1990 Core Competencies and Key Skills for Missouri Schools, grades two through ten. (The list can also stand alone as a general list of math skills.) The column is blank for any vocational competency that the committee members decided did not require math skills.

Additional information about the math skills listed in the second column of the matrix may be found in the appendix following the matrix. The appendix is based on the math skills identified in the 1990 Core Competencies and Key Skills for Missouri Schools.

The last column tells whether the math skills will be new to students in the vocational classroom or whether they have been covered by math courses in the second through tenth grades. You may want to review and/or reinforce the math skills that students already have, and to make arrangements for them to learn the skills that are new to them.

As you use the matrix to help students learn or review math skills, keep in mind that different students learn in different ways. Efforts should be made to ensure that all students have an equal opportunity to understand and learn the material, regardless of race, color, national origin, gender, age, or disability.

Hold high expectations for all students, and provide the instruction necessary for students to meet those expectations. It is important that students achieve in math because research has shown a link between attitude toward mathematics and science, self-esteem levels, and career aspirations. According to a survey by the American Association of University Women: "Girls and boys who like mathematics and science have higher self-esteem, more ambitious career goals, and are more likely to hold onto their dreams."

As you help students achieve and develop this positive attitude toward mathematics, be aware that students of different genders give different reasons for their lack of interest in math. The AAUW survey states: "The gender differences in the intertwining of self-esteem and math/science interest is most evident in girls' and boys' reasons for their declining interest in math and science. While boys 'externalize' by seeing math and science as unimportant, girls 'internalize' by thinking themselves not smart enough."

GRAPHIC ARTS (OFFSET LITHOGRAPHY)		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
B1. Prepare a rough layout	Computation • Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement • Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R
	Problem Solving • Identify impediments to solving a given problem (9G-3)	R
	Consumer Problems • Solve problems using proportion in consumer situations (9H-2) • Solve problems using ratio and proportion in consumer situations (7H-4)	R
B2. Indicate how photographs and headings are to be printed for layout person		
B3. Indicate percentage of enlargement or reduction required on photos	Computation • Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Consumer Problems • Solve problems using ratio and proportion in consumer situations (7H-4)	R

GRAPHIC ARTS (OFFSET LITHOGRAPHY)		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
B4. Indicate typefaces and point sizes to be used in typesetting	Computation	
	• Add and subtract whole numbers with up to four addends (4B-4)	R
	• Multiply and divide whole numbers (3-digit by 2-digit) (5B-5)	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R

GRAPHIC ARTS (OFFSET LITHOGRAPHY)		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
B5. Make dummy layout of multipage printed product for signature specifications	Computation	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	
	Measurement	R
	• Choose the appropriate unit of precision for a given measurement situation (7D-1) • Solve problems involving measurement (7D-11)	R
	Problem Solving	R
B6. Place crop marks on pictures	• Identify impediments to solving a given problem (9G-3)	
	Consumer Problems	R
	• Solve problems using proportion in consumer situations (9H-2)	
	Computation	R
	• Add and subtract whole numbers with up to four addends (4B-4)	
	Measurement	R
	• Choose the appropriate unit of precision for a given measurement situation (7D-1) • Solve problems involving measurement (7D-11)	R
	Consumer Problems	R
	• Solve problems using ratio and proportion in consumer situations (7H-4)	

GRAPHIC ARTS (OFFSET LITHOGRAPHY)		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
B7. Produce a comprehensive layout	Computation • Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement • Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R
B8. Revise layouts to customer specifications	Computation • Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement • Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R
	Problem Solving • Identify impediments to solving a given problem (9G-3)	R
	Consumer Problems • Solve problems using proportion in consumer situations (9H-2) • Solve problems using ratio and proportion in consumer situations (7H-4)	R

GRAPHIC ARTS (OFFSET LITHOGRAPHY)		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
B9. Secure photocopied galley proofs in position on comprehensive layout	Computation • Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement • Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R
	Problem Solving • Identify impediments to solving a given problem (9G-3)	R
	Consumer Problems • Solve problems using proportion in consumer situations (9H-2)	R
B10. Sketch proposed customer's rough layout		

GRAPHIC ARTS (OFFSET LITHOGRAPHY)		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
C1. Justify copy on an impact machine	Computation • Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement • Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R
	Problem Solving • Identify impediments to solving a given problem (9G-3)	R
	Consumer Problems • Solve problems using proportion in consumer situations (9H-2)	R
C2. Make heading using press types	Computation • Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement • Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R
	Consumer Problems • Solve problems using ratio and proportion in consumer situations (7H-4)	R

GRAPHIC ARTS (OFFSET LITHOGRAPHY)		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
C3. Make headlines with display typesetter	Computation • Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement • Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R
	Problem Solving • Identify impediments to solving a given problem (9G-3)	R
	Consumer Problems • Solve problems using proportion in consumer situations (9H-2) • Solve problems using ratio and proportion in consumer situations (7H-4)	R

GRAPHIC ARTS (OFFSET LITHOGRAPHY)		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
C4. Program and type copy on a photographic input composition machine	Computation	
	• Multiply and divide whole numbers (3-digit by 2-digit) (5B-5)	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R
	Problem Solving	
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R
	Consumer Problems	
	• Solve problems using proportion in consumer situations (9H-2)	R
	• Solve problems using ratio and proportion in consumer situations (7H-4)	R

GRAPHIC ARTS (OFFSET LITHOGRAPHY)		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
C5. Process photographic composition galley pages using processor	Computation Multiply and divide whole numbers (3-digit by 2-digit) (5B-5)	R
	Measurement Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Solve problems involving measurement (7D-11)	R
C6. Make photocopies of galleys	Computation Compute solutions of problems involving percents (7B-12)	R
C7. Proofread all galley copy		
C8. Code for corrections		
C9. Distribute corrected proofs of copy (to proper departments)		
C10. Read and compare type composition against customer-approved comprehensive layout	Computation Compute solutions of problems involving percents (7B-12)	R
	Measurement Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Solve problems involving measurement (7D-11)	R
	Consumer Problems Solve problems using ratio and proportion in consumer situations (7H-4)	R

GRAPHIC ARTS (OFFSET LITHOGRAPHY)		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
C11. Code for typestyles, leading, line length and point sizes	Computation • Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement • Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R
	Consumer Problems • Solve problems using ratio and proportion in consumer situations (7H-4)	R
C12. Read and compare final layout against customer-approved comprehensive layout		
C13. Set type using hand-set type method	Computation • Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement • Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R
	Problem Solving • Identify impediments to solving a given problem (9G-3)	R
	Consumer Problems • Solve problems using proportion in consumer situations (9H-2)	R

GRAPHIC ARTS (OFFSET LITHOGRAPHY)		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
C14. Make up jobs with machine set type	Computation • Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement • Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R
	Problem Solving • Identify impediments to solving a given problem (9G-3)	R
	Consumer Problems • Solve problems using ratio and proportion in consumer situations (7H-4)	R

GRAPHIC ARTS (OFFSET LITHOGRAPHY)		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
D1. Draw up base sheet for final paste-up	Computation • Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement • Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R
	Problem Solving • Identify impediments to solving a given problem (9G-3)	R
	Consumer Problems • Solve problems using ratio and proportion in consumer situations (7H-4)	R

GRAPHIC ARTS (OFFSET LITHOGRAPHY)		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
D2. Trim galley sheets	Computation • Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement • Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R
	Problem Solving • Identify impediments to solving a given problem (9G-3)	R
	Consumer Problems • Solve problems using ratio and proportion in consumer situations (7H-4)	R
D3. Apply adhesives (rubber cement, wax, tape)		

GRAPHIC ARTS (OFFSET LITHOGRAPHY)		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
D4. Check all proportions and sizes with job requirements	Computation • Compute the sum, difference, product, or quotient of fractions (7B-8) • Compute solutions of problems involving percents (7B-12) Measurement • Choose the appropriate unit of precision for a given measurement situation (7D-1) • Solve problems involving measurement (7D-11) Problem Solving • Identify impediments to solving a given problem (9G-3) Consumer Problems • Solve problems using ratio and proportion in consumer situations (7H-4)	R R R R R R

GRAPHIC ARTS (OFFSET LITHOGRAPHY)		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
D5. Crop and size all photographs	Computation	
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R
	Consumer Problems	
	• Solve problems using ratio and proportion in consumer situations (7H-4)	R

GRAPHIC ARTS (OFFSET LITHOGRAPHY)		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
D6. Use diffusion transfer process to make enlargements or reductions	Computation	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Measurement	R
	• Tell and record time (3D-3)	R
D7. Trim prescreened photographs	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R
	Consumer Problems	R
	• Solve problems using ratio and proportion in consumer situations (7H-4)	R
	Computation	R
D7. Trim prescreened photographs	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement	R
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R

GRAPHIC ARTS (OFFSET LITHOGRAPHY)		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
D8. Keyline pictures	Computation - Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6) - Compute the sum, difference, product, or quotient of fractions (7B-8) Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Solve problems involving measurement (7D-11) Problem Solving - Identify impediments to solving a given problem (9G-3)	R R R R R
D9. Place all illustrations and typed matter in position on base sheet (paste-up)	Computation - Compute the sum, difference, product, or quotient of fractions (7B-8) Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Solve problems involving measurement (7D-11) Consumer Problems - Solve problems using ratio and proportion in consumer situations (7H-4)	R R R R
D10. Make alterations on existing photographs		

GRAPHIC ARTS (OFFSET LITHOGRAPHY)		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
D11. Locate and use clip-art	Computation	
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	• Compute solutions of problems involving percents (7B-12)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R
	Problem Solving	
	• Identify impediments to solving a given problem (9G-3)	R
	Consumer Problems	
	• Solve problems using ratio and proportion in consumer situations (7H-4)	R

GRAPHIC ARTS (OFFSET LITHOGRAPHY)		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
D12. Apply dry transfers (lettering, screens)	Computation	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	
	Measurement	R
	• Choose the appropriate unit of precision for a given measurement situation (7D-1) • Solve problems involving measurement (7D-11)	R
D13. Cut panels for halftones and reverses	Consumer Problems	R
	• Solve problems using ratio and proportion in consumer situations (7H-4)	
	Computation	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	
	Measurement	R
	• Choose the appropriate unit of precision for a given measurement situation (7D-1) • Solve problems involving measurement (7D-11)	R
	Consumer Problems	R
	• Solve problems using ratio and proportion in consumer situations (7H-4)	

GRAPHIC ARTS (OFFSET LITHOGRAPHY)		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
D14. Cut masking film for multicolor overlays	Computation • Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement • Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R
	Consumer Problems • Solve problems using ratio and proportion in consumer situations (7H-4)	R
D15. Position and secure overlays and tissues		
D16. Compare artwork to customer-approved comprehensive layout		
D17. Check camera-ready copy for photo reproduction quality		
D18. Photocopy page proofs		
D19. Return paste-up with corrections marked to composition if required		
E1. Clean and maintain gallery and darkroom		
E2. Sort work to be photographed into line copy, halftone copy, and color copy		

GRAPHIC ARTS (OFFSET LITHOGRAPHY)		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
E3. Make exposure tests (line exposure)	Computation	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	
	Measurement	R
	• Choose the appropriate unit of precision for a given measurement situation (7D-1) • Tell and record time (3D-3) • Solve problems involving measurement (7D-11)	R
E4. Use camera filters if necessary for appropriate color copy	Computation	R
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6) • Compute the sum, difference, product, or quotient of fractions (7B-8)	R
E5. Expose line work with line film	Computation	R
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	
	Measurement	R
	• Tell and record time (3D-3)	
	Consumer Problems	R
	• Solve problems using ratio and proportion in consumer situations (7H-4)	

GRAPHIC ARTS (OFFSET LITHOGRAPHY)		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
E6. Determine basic density range of screen	Computation	
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
E7. Determine density range of continuous tone copy with densitometer or gray scale	• Compute solutions of problems involving percents (7B-12)	R
	Computation	
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	• Compute solutions of problems involving percents (7B-12)	R

GRAPHIC ARTS (OFFSET LITHOGRAPHY)		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
E8. Determine exposure through use of Kodak (negative halftone) computer	Computation • Compute the sum, difference, product, or quotient of fractions (7B-8) • Compute solutions of problems involving percents (7B-12) Measurement • Choose the appropriate unit of precision for a given measurement situation (7D-1) • Tell and record time (3D-3) • Solve problems involving measurement (7D-11)	R R R R R
E9. Make exposure with computer integrated system and/or time system		
E10. Expose photograph using contact halftone screen		
E11. Use rapid access materials		
E12. Use duplicating film for line work		
F1. Mix processing chemicals	Measurement • Choose the appropriate unit of precision for a given measurement situation (7D-1) • Measure length, weight (mass), volume, and capacity using nonstandard and standard units (3D-5) • Solve problems involving measurement (7D-11)	R R R

GRAPHIC ARTS (OFFSET LITHOGRAPHY)		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
F2. Develop film to proper density by time and temperature methods	Measurement	
	Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Measure length, weight (mass), volume, and capacity using nonstandard and standard units (3D-5)	R
F3. Develop film to proper density by gray scale method	Measurement	
	Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
F4. Develop film to proper density by visual method	Measurement	
	Solve problems involving measurement (7D-11)	R
F5. Dry film		
F6. Inspect negative for quality and density		
F7. Run and evaluate test strip from automatic film processor		
F8. Process negative through automatic film processor		
F9. Inspect negatives for density, quality, and size		
F10. Process rapid access materials in tray or rapid access processor		

GRAPHIC ARTS (OFFSET LITHOGRAPHY)		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
I2. Use Dylux, dry proofing system	Measurement Tell and record time (3D-3)	R
I3. Use overlay proofing system (by hand and/or machine)		
I4. Use powdered toning proofing system (chromolin)		
I5. Use laminated proofing system		
I6. Run press proofs		
I7. Check proofs under proper lighting conditions		
I8. Show proofs to customers		
I9. Strip changes and corrections into flat	Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Solve problems involving measurement (7D-11)	R R
I10. Make revised proofs		
J1. Check flat for imperfections, scratches, block images and imposition		
J2. Position flat on top of plate in register in vacuum frame		
J3. Expose plate for predetermined time	Measurement Tell and record time (3D-3)	R
J4. Expose all additional masks or multiple burns required for each plate	Measurement Tell and record time (3D-3)	R
J5. Process additive plate by hand		

GRAPHIC ARTS (OFFSET LITHOGRAPHY)		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
K6. Adjust impression to caliper of paper		
K7. Feed paper through press and set all guides	Computation • Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement • Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R
K8. Measure and mix dampener fountain solution	Computation • Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement • Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Measure length, weight (mass), volume, and capacity using nonstandard and standard units (3D-5)	R
	• Solve problems involving measurement (7D-11)	R
K9. Put dampener fountain solution in press		
K10. Ink up press		
K11. Clean gum off metal plate with water		

GRAPHIC ARTS (OFFSET LITHOGRAPHY)		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
K15. Adjust color head (lateral adjustment) to match up with first head if two-color job	Computation	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	
	Measurement	R
	• Choose the appropriate unit of precision for a given measurement situation (7D-1) • Solve problems involving measurement (7D-11)	R
	Consumer Problems	R
	• Solve problems using ratio and proportion in consumer situations (7H-4)	
K16. Maintain register		
K17. Correct for washed-out and/or over-inked copy		
K18. Use reflection densitometer to get uniform ink coverage	Computation	R
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	
	Measurement	R
	• Choose the appropriate unit of precision for a given measurement situation (7D-1) • Solve problems involving measurement (7D-11)	R
K19. Wipe off particles of dust or dried ink (hickies) from plate		

GRAPHIC ARTS (OFFSET LITHOGRAPHY)		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
K20. Perforate and score on press	Computation • Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement • Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R
	Consumer Problems • Solve problems using ratio and proportion in consumer situations (7H-4)	R
K21. Maintain pH in fountain solution (conductivity)	Measurement • Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R
K22. Test water in press regularly with litmus paper	Measurement • Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R
K23. Run solid color straight through		
K24. Run two-color line work		
K25. Run four-color separations		
K26. Pull progressive proofs		
K27. Set gauge for spray powder		

GRAPHIC ARTS (OFFSET LITHOGRAPHY)		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
K28. End run		
K29. Unload stock		
K30. Remove plate		
K31. Wash up press		
K32. Change roller covers		
K33. Repair electrical malfunctions		
K34. Repair mechanical malfunctions		
K35. Lubricate press		
K36. Clean press		
L1. Jog paper manually or by machine		
L2. Jog paper on table model jogger		
L3. Jog large sheets of paper		
L4. Prepare cutting layout	Computation • Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6) • Compute the sum, difference, product, or quotient of fractions (7B-8) Measurement • Choose the appropriate unit of precision for a given measurement situation (7D-1) • Solve problems involving measurement (7D-11)	R R R R

GRAPHIC ARTS (OFFSET LITHOGRAPHY)		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
L23. Trim job after binding	Computation • Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement • Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R
L24. Drill stock	Computation • Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement • Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R
L25. Gather and collate by hand and machine		
L26. Perforate with pin bar on special machine to punch holes in sheet	Computation • Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement • Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R

GRAPHIC ARTS (OFFSET LITHOGRAPHY)		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
L27. Perforate using rotary perforating machine		
M1. Receive paper, check invoices, and store	Computation - Add and subtract whole numbers with up to four addends (4B-4) - Multiply and divide whole numbers (3-digit by 2-digit) (5B-5) - Compute the sum, difference, product, or quotient of fractions (7B-8)	R R R
M2. Handle paper without damaging, spilling, or shifting its load in stock		
M3. Count paper (inventory)	Computation - Add and subtract whole numbers with up to four addends (4B-4) - Multiply and divide whole numbers (3-digit by 2-digit) (5B-5) - Compute the sum, difference, product, or quotient of fractions (7B-8)	R R R
M4. Transport paper, manually or otherwise		
N1. Perform heat shrink wrapping		
N2. Wrap package with Kraft paper		
N3. Wrap packages with cello and tape		

GRAPHIC ARTS (OFFSET LITHOGRAPHY)		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
N4. Box completed job	Computation - Add and subtract whole numbers with up to four addends (4B-4) - Multiply and divide whole numbers (3-digit by 2-digit) (5B-5) - Compute the sum, difference, product, or quotient of fractions (7B-8)	R R R
N5. Label ends of boxes	Computation - Add and subtract whole numbers with up to four addends (4B-4) - Multiply and divide whole numbers (3-digit by 2-digit) (5B-5) - Compute the sum, difference, product, or quotient of fractions (7B-8)	R R R
N6. Band packages	Computation - Add and subtract whole numbers with up to four addends (4B-4) - Multiply and divide whole numbers (3-digit by 2-digit) (5B-5) - Compute the sum, difference, product, or quotient of fractions (7B-8)	R R R
N7. Address labels on package		

GRAPHIC ARTS (OFFSET LITHOGRAPHY)		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
O5. Preventive maintenance		

APPENDIX:
Additional Math Skills Information

**Based on
1990 Core Competencies And Key Skills
For Missouri Schools**

**Mathematics
Grade 2-10**

GRADE LEVEL 2	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
2	2 Compare whole numbers 3 Identify place value a the digit in the ones', tens', or hundreds' place b the place value of a given digit by name c the value of a digit in the ones', tens', or hundreds' place 4 Complete and create patterns a number b geometric c graphic 6 Identify fractional parts	2 Add whole numbers 3 Subtract whole numbers 7 Explore the use of open sentences to describe mathematical relationships a involving addition b involving subtraction c which represent given computational situations		3 Tell and record time	1 Describe, model, draw, and classify shapes a rectangles and squares b circles c triangles	2 Construct, read, and interpret displays of data a bar graphs b pictographs c other displays of data		2 Solve word problems involving addition 3 Solve word problems involving subtraction

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GRADE LEVEL 3	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
3	2 Compare numbers a compare two numbers using < or > b order a set of numbers by magnitude 3 Identify place value a the digit in the ones', tens', hundreds', or thousands' place b the place value of a given digit by name c the value of a digit in the ones', tens', hundreds', or thousands' place 6 Identify fractional parts	4 Add and subtract whole numbers with regrouping 5 Multiply whole numbers 7 Explore the use of open sentences to describe mathematical relationships a involving addition b involving subtraction c involving multiplication and division d identify open sentences that represent given computational situations		3 Tell and record time a relate various recording - conventions to each other 5 Measure length, weight (mass), volume, and capacity using nonstandard and standard units a nearest inch b nearest centimeter c nearest pound or kilogram d nearest cup, pint, quart, gallon, and liter	2 Identify cones, cylinders, spheres, pyramids, and cubes	2 Construct, read, and interpret displays of data a read bar graphs and pictographs b contrast displays of data c interpret displays of data 3 Locate points on a grid		2 Solve word problems involving addition and subtraction of money 4 Solve word problems using addition, subtraction, and multiplication

GRADE LEVEL 4	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
4	3 Identify place value a the digit in the ones', tens', hundreds', thousands', or ten thousands' place b the place value of a given digit by name through ten thousands c the value of a specified digit(s) through the ten thousands' place 6 Graph points representing fractions on a number line a select the fraction represented by a given point on a number line b select the point on a number line representing a given fraction	4 Add and subtract whole numbers with up to four addends 5 Multiply whole numbers (3-digit by 1-digit) 7 Use open sentences to express mathematical relationships a identify the open sentence which represents a computational situation involving addition and/or subtraction, and multiplication and/or division b identify the computational situation which represents an open sentence involving addition and/or subtraction and multiplication and/or division	3 Recognize a situation in which an estimate or an exact answer is appropriate	2 Estimate measurements including area and perimeter of regular and irregular regions 5 Measure lengths a to the nearest half inch b to the nearest centimeter	2 Explore properties of right angles	2 Construct, read, and interpret displays of data a select bar graphs and pictographs b contrast displays of data		2 Solve problems involving money management a with computational algorithms b which may require nonstandard strategies 4 Solve standard multi-step word problems, using one or more than one operation 5 Solve nonstandard word problems

GRADE LEVEL 5	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
5	2 Compare unit fractions a compare two fractions using $<$ or $>$ b order a set of fractions by magnitude 3 Compare decimals a compare two decimals using $<$, $>$, or $=$ b order a set of decimals by magnitude 7 Apply number theory concepts a factors b multiples	5 Multiply and divide whole numbers (3-digit by 2-digit) 7 Solve number sentences a involving addition and subtraction with whole numbers and/or decimals b involving multiplication and division with whole numbers with 1-digit multipliers and divisors 8 Add and subtract like fractions	2 Use estimation strategies and mental computation to determine whether an answer is reasonable	2 Estimate measurements a linear measure b area, mass, and volume measures 6 Measure area and perimeter of regular and irregular regions using nonstandard and standard units 9 Convert units of measure within a system a metric system b English system	1 Identify properties of lines a intersecting, parallel, and perpendicular lines b vertical, horizontal, and diagonal (oblique) lines 4 Compare and classify geometric shapes and solids a similar figures b congruent figures c identify a figure with a specified number of lines of symmetry d regular polygons e right triangles	1 Systematically collect, organize, and describe data a best method for collecting data b accurate organization of given data c describe data using ratio and proportion 2 Construct, read, and interpret displays of data a identify graphs that accurately represent given data b interpret displays of data c construct displays of data		4 Solve standard multi-step word problems 5 Solve nonstandard word problems

GRADE LEVEL 6	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
6	2 Compare fractions and decimals a compare two fractions using $<$, $>$, or $=$ b compare two decimals using $<$, $>$, or $=$ c order a set of fractions or decimals by magnitude 4 Compare a numerical sequence 6 Graph points representing positive rational numbers on a number line a select the fraction or decimal represented by a given point b select the point representing a given fraction or decimal	6 Add, subtract, multiply, and divide whole numbers 7 Solve number sentences a involving whole numbers and decimals b involving whole numbers and like fractions 8 Multiply fractions a whole numbers and fractions b fractions with denominators less than 10 9 Use operations in the correct order		1 Choose an appropriate unit of measure and the corresponding tool for a given situation a within the metric system b within the English system 6 Calculate areas and perimeters a of squares and rectangles 9 Convert units of measure within a system a metric system b English system	4 Compare and classify geometric shapes and solids a similar figures b congruent figures c identify a figure with a specified number of lines of symmetry d regular polygons e right triangles	1 Systematically collect, organize, and describe data a best method for collecting data b accurate organization of given data 2 Construct, read, and interpret displays of data a identify graphs that accurately represent given data b interpret displays of data c construct displays of data		1 Solve word problems involving money 4 Solve standard multi-step word problems 5 Solve nonstandard word problems

GRADE LEVEL 7	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
7	1 Communicate and interpret numbers a interpret calculator displays b express numbers in scientific notation with positive exponents c express large numbers in conventional notation 2 Compare positive rational numbers a compare fraction to fraction b compare decimal to fraction 5 Use numerical relationships to describe and simplify numerical situations 7 Apply number theory concepts a classify numbers as prime or composite b factors c multiples d multiple classifications	1 Recall fraction/decimal/percent equivalents 7 Solve linear equations (number sentences) a one-step b two-step 8 Compute the sum, difference, product, or quotient of fractions 9 Use operations in correct order a with + and/or - and + b with + and/or - and x 12 Compute solutions of problems involving percents a calculate percent of a number b calculate percent one number is of another c calculate the whole when a percent is given	1 Determine a reasonable estimate 2 Use estimation strategies and mental computation to determine if an answer is reasonable 5 Solve problems utilizing estimation a utilizing percents b utilizing fractions c utilizing decimals	1 Choose the appropriate unit of precision for a given measurement situation a in metric measurements b in standard measurements 2 Estimate measurement 6 Approximate and/or calculate areas and perimeters of irregularly shaped regions 10 Investigate the relationships among circumference, area, and diameter of a circle 11 Solve problems involving measurement	1 Recognize properties and relationships of lines and angles 2 Classify polygons a classify regular polygons with five or more sides b classify irregular polygons with five or more sides c classify quadrilaterals 3 Determine lines of symmetry in natural and geometric figures a in a natural figure b in a plane geometric figure 5 Identify the plane geometric figures which form the surfaces of three dimensional projects	1 Systematically collect, organize, and classify data a collect and organize statistical data b describe the most appropriate measure c determine mean d determine median e determine mode f determine range 2 Construct, read, and interpret displays of data a construct graphic data displays b identify correctly constructed bar and line graphs, pie charts, pictographs, and scattergrams c interpret bar and line graphs, pie charts, pictographs, and scattergrams 3 Formulate and solve problems that involve collecting and analyzing data	1 Create a problem to illustrate a given numerical sentence 2 Write a number sentence to illustrate a problem 3 Identify unnecessary or missing numerical data in a word problem	2 Solve problems involving percent in consumer situations a sales tax b discount c commission 4 Solve problems using ratio and proportion in consumer situations a involving pricing b involving recipe conversion c involving medication dosage d involving relative distances between locations

GRADE LEVEL 8	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
8	1 Communicate and interpret numbers a convert rational numbers to scientific notation b convert scientific notation to rational numbers 2 Compare rational numbers a compare fraction to fraction b compare decimal to fraction 5 Use mathematical relationships to describe and simplify mathematical expressions 7 Apply number theory a determine powers b determine square roots c determine cube roots	6 Compute the sum, difference, product, or quotient of integers 7 Solve linear equations a one-step b two-step 9 Evaluate algebraic expressions, given values for the variables	2 Use estimation strategies and mental computation to determine if an answer is reasonable 5 Solve problems utilizing estimation a utilizing percents b utilizing fractions c utilizing decimals	2 Estimate measurement 6 Calculate the perimeter or the area of a triangle, rectangle, or square 10 Calculate the circumference or the area of a circle 11 Solve problems involving measurement	1 Recognize properties and relationships of lines and angles a identify bisectors b identify radii c identify diagonals d identify diameters e identify interior angles f identify exterior angles 2 Classify polygons a classify triangles by sides/angles b classify quadrilaterals (e.g., parallelogram, rectangle, rhombus, trapezoid) 3 Recognize similar and congruent figures 5 Visualize, draw, and construct geometric figures	3 Formulate and solve problems that involve collecting and analyzing data 4 Calculate and interpret the probability of an event	1 Create a word problem to illustrate a given equation, or write an equation to illustrate a given problem 4 Follow a series of instructions in sequential order a in a flow chart b in a diagram c in a narrative	1 Solve problems involving money in consumer situations a involving simple interest b involving total cost of installment purchases c involving total cost of purchases including sales tax d involving discounts e involving sale prices 3 Solve problems involving area and perimeter in consumer situations 4 Solve problems using proportion in consumer situations a involving pricing b involving recipe conversion c involving medication dosage d involving relative distances between locations

GRADE LEVEL 9	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
9	5 Use mathematical relationships to simplify expressions a mathematical expressions b algebraic expressions 7 Apply number theory concepts	2 Compute using scientific notation 7 Solve linear equations a one/two steps with integral coefficients and integral or rational solutions	2 Judge reasonableness of solutions or estimates of solutions to problems 4 Determine the relative magnitude of fractional numbers 5 Solve problems utilizing estimation a consumer situations b practical situations	5 Compute the area and perimeter of irregularly shaped figures 11 Solve problems involving measurement a volume of cylinders b volume of rectangular solids	1 Recognize properties and relationships of lines and angles 4 Determine if a given point is on the graph of a given equation 5 Visualize, draw, and construct geometric figures 6 Solve problems using measures of inclination: (slope)	2 Calculate and interpret the probability of an event 3 Formulate and solve problems that involve collecting and analyzing statistical data a draw inferences b evaluate conclusions c solve problems involving mean, median, mode, and range 4 Judge the reliability of inferences drawn from statistical data	1 Translate word phrases and sentences into algebraic expressions and equations 2 Evaluate the validity of conclusions drawn from given premises and definitions 3 Identify impediments to solving a given problem a information to solve a problem b information missing to solve a problem c information unnecessary to solve a problem d information that needs to be converted to another form	1 Solve problems involving volume and area in consumer situations 2 Solve problems using proportion in consumer situations a involving pricing b involving food, recipes, and nutrition c involving medication dosage d involving relative distances between locations 3 Investigate problems involving personal finance 4 Compute gross pay using hourly, monthly, commission, piecework, and/or overtime rates

GRADE LEVEL 10	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
10	5 Use mathematical relationships to simplify expressions a mathematical expressions b algebraic expressions	7 Solve linear equations a with decimal coefficients b with fractional coefficients c with integral coefficients 10 Solve formulas for a given variable	1 Estimate solutions for various computational problems a using scientific notation b using whole numbers c using fractions d using decimals 2 Judge reasonableness of solutions 5 Solve problems utilizing estimation a on consumer situations b on practical situations	5 Solve problems requiring the application of the Pythagorean theorem a given diagrams and measurements of right triangles b given a situation involving a right triangle 11 Solve problems involving measurement	1 Recognize properties and relationships of lines and angles a parallel and perpendicular lines b complementary and supplementary angles c alternate interior and corresponding angles d calculate the third angle of a triangle 3 Graph equations a plot the graph of a linear equation b identify the graph of a linear equation c identify the slope of a line given its graph and equation d use the graph of a line to identify its equation 5 Visualize, draw, and construct geometric figures 6 Solve problems using the concepts of symmetry, similarity, and congruence a determine lines of symmetry b use the concept of congruence	2 Calculate and interpret the probability of an event 3 Identify limitations of an inference drawn from statistical data a limitations to an inference b additional information needed c demonstrable bias	1 State logical conclusions from given conditions 2 Evaluate the acceptability of a conclusion drawn through logical inference	2 Solve banking problems related to maintaining a checking account 4 Use appropriate information and tables to compute net pay, considering Social Security deductions, state and federal taxes, etc.

INTEGRATING VOCATIONAL COMPETENCIES AND MATH SKILLS

HEALTH SERVICES ASSISTANT

Available from the
Instructional Materials Laboratory
University of Missouri-Columbia
10 London Hall
Columbia, Missouri 65211
314-882-2883
Catalog Number 65-7500-1

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FOREWORD

National interest and legislation support the need for identifying core competencies and key skills taught in industrial education classes. An understanding of the basic competencies involved will help identify academic subjects as they relate to specific occupations.

The following program area/math skills matrix can therefore be a valuable resource for program integration of academics, pre-testing and skills assessment, and special needs curriculum development. It identifies the math core competencies and key skills required for/taught in one of ten program areas at the Missouri secondary level. Matrices were developed for: Air Conditioning, Heating, and Refrigeration; Auto Collision Technology; Automotive Technology; Building Trades; Drafting; Electronics; Graphic Arts (Offset Lithography); Health Services Assistant; Machine Technology; and Welding.

The materials used to create the matrix include: the 1990 Core Competencies and Key Skills for Missouri Schools, grades two through ten; and Instructional Materials Laboratory vocational program competency profiles for the program areas involved.

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TO THE INSTRUCTOR: SUGGESTIONS FOR USE

The matrix that follows is divided into three columns. Reading in a row across all three of the columns will identify which math skills are involved in each vocational competency and tell whether the math skills are new to students or simply need reinforcement.

The first column identifies the vocational competencies involved in the program area. The numbers and competencies in this column refer to the Instructional Materials Laboratory competency profile for the program area.

The second column identifies which math skills are involved in the vocational competencies. The skills and numbers listed in this column refer to the 1990 Core Competencies and Key Skills for Missouri Schools, grades two through ten. (The list can also stand alone as a general list of math skills.) The column is blank for any vocational competency that the committee members decided did not require math skills.

Additional information about the math skills listed in the second column of the matrix may be found in the appendix following the matrix. The appendix is based on the math skills identified in the 1990 Core Competencies and Key Skills for Missouri Schools.

The last column tells whether the math skills will be new to students in the vocational classroom or whether they have been covered by math courses in the second through tenth grades. You may want to review and/or reinforce the math skills that students already have, and to make arrangements for them to learn the skills that are new to them.

As you use the matrix to help students learn or review math skills, keep in mind that different students learn in different ways. Efforts should be made to ensure that all students have an equal opportunity to understand and learn the material, regardless of race, color, national origin, gender, age, or disability.

Hold high expectations for all students, and provide the instruction necessary for students to meet those expectations. It is important that students achieve in math because research has shown a link between attitude toward mathematics and science, self-esteem levels, and career aspirations. According to a survey by the American Association of University Women: "Girls and boys who like mathematics and science have higher self-esteem, more ambitious career goals, and are more likely to hold onto their dreams."

As you help students achieve and develop this positive attitude toward mathematics, be aware that students of different genders give different reasons for their lack of interest in math. The AAUW survey states: "The gender differences in the intertwining of self-esteem and math/science interest is most evident in girls' and boys' reasons for their declining interest in math and science. While boys 'externalize' by seeing math and science as unimportant, girls 'internalize' by thinking themselves not smart enough."

HEALTH SERVICES ASSISTANT		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
A1. Follow classroom rules and regulations		
A2. Identify types of health care facilities		
A3. Identify members of the health care team and their functions		
A4. Identify health care assistant qualities and traits		
A5. Demonstrate health care assistant qualities and traits		
A6. Define terminology related to medical/legal problems		
A7. Demonstrate knowledge of patient/resident rights		
B1. Demonstrate knowledge of job seeking skills		
B2. List factors in selecting a job		
B3. Prepare a resume		
B4. Prepare a job application		
B5. Participate in a job interview		
B6. Prepare letters relating to job seeking		
B7. List types of payroll deductions		
B8. Demonstrate knowledge of desirable employee qualities		
B9. Practice good personal hygiene		
B10. Maintain good personal hygiene		
B11. Wear appropriate clothes and accessories		
B12. Identify employee rights		

HEALTH SERVICES ASSISTANT		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
C1. Define terminology associated with microbiology		
C2. Classify microorganisms		
C3. Label types of bacteria		
C4. Identify methods of laboratory bacterial transmission		
C5. List factors affecting microorganism growth		
C6. Define terminology related to infectious disease/asepsis		
C7. List types of infectious diseases		
C8. Describe pathogenic effects on the body		
C9. Identify methods of laboratory diagnosis		
C10. Identify methods used to control infection		
C11. Demonstrate sterile techniques		
C12. Demonstrate isolation techniques		
C13. Differentiate between diagnosis of AIDS and ARC		
C14. List nonspecific symptoms leading to diagnosis of AIDS/ARC		
C15. Recognize at least four procedures to prevent AIDS/ARC transmission to/from health care worker		
D1. Define terminology associated with body planes/directions		
D2. Identify anatomical positions		

HEALTH SERVICES ASSISTANT		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
D3. Identify body cavities, subdivisions and major organs		
D4. Identify abdominal regions		
D5. Identify cell parts and define their functions		
D6. List basic types of body tissues/membranes/organs		
D7. Describe functions of body tissues/membranes/organs		
D8. List the eleven body systems, their structures and related functions		
E1. Define terminology pertaining to the skeletal system		
E2. List the functions of the skeletal system		
E3. List types of bones composition markings and linings		
E4. List the divisions of the skeleton		
E5. Identify the bones of the body		
E6. Identify the types of joints and their functions		
F1. Define terminology pertaining to the muscular system		
F2. Identify types of muscles		
F3. Identify parts of muscles and their functions		
F4. Identify major muscles and their attachments		
G1. Define terminology pertaining to the skin system		

HEALTH SERVICES ASSISTANT		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
G2. Identify the structures of skin		
G3. Describe the functions of skin		
G4. Describe how the skin regulates body temperature		
G5. Identify skin appendages and their functions		
H1. Define terminology associated with the respiratory system		
H2. Define types of respiration		
H3. Identify respiratory organs and their functions		
H4. Describe the steps of the respiratory process		
H5. List the factors affecting respiratory rate		
I1. Define terminology associated with the heart		
I2. Identify the location and structure of the heart		
I3. Describe the functions of the heart		
I4. Describe/diagram the electrical conduction system of the heart		
I5. Describe functions of the conduction system components		
I6. Describe/diagram the path of circulation through the heart		
I7. Demonstrate CPR technique		
I8. Demonstrate Heimlich maneuver		
I9. Identify types of blood vessels		

HEALTH SERVICES ASSISTANT		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
I10. Discuss the function of the blood vessels		
I11. Define pulse		
I12. List factors affecting pulse		
I13. Define terminology associated with circulation		
I14. Describe types of circulation		
I15. Define terminology associated with blood		
I16. Describe the amount and function of blood		
I17. Identify blood components and list functions of formed elements		
I18. List areas of blood production/destruction of formed elements		
I19. List the causes of bleeding		
I20. Define terminology associated with the lymphatic system		
I21. List the functions of the lymphatic vessels and organs		
I22. Identify major lymphatic vessels and organs		
I23. Discuss functions of lymphatic vessels		
I24. Identify major nodes and their functions		
J1. Define terminology associated with the digestive system		
J2. Identify true organs		

HEALTH SERVICES ASSISTANT		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
J3. Identify accessory organs		
J4. List the functions of the digestive system		
J5. Describe/diagram the path of foods through the digestive system		
K1. Define nutrients		
K2. Define intermediary metabolism		
K3. Describe the relationship between energy and caloric intake	Computation Solve linear equations (number sentences) (7B-7)	R
K4. List the basic food groups		
K5. Identify balanced, special and substitute diets		
K6. Describe strategies for forcing fluids		
L1. Define terms associated with the endocrine system		
L2. Identify glands and their functions		
L3. List types of hormones and describe their functions		
M1. Define terminology associated with the nervous system		
M2. Identify types of neurons		
M3. Identify the divisions of the nervous system		
M4. Label divisions of the brain and spinal cord		
N1. Define terminology associated with the sensory system		

HEALTH SERVICES ASSISTANT		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
N2. Identify components of the sensory system		
N3. Identify and describe the functions of the parts of the eye		
N4. Identify and describe the functions of the parts of the ear		
O1. Define terminology associated with the urinary system		
O2. Identify organs of the urinary system and describe their functions		
O3. Identify the parts of the kidney		
O4. List normal and abnormal substances of urine		
P1. Define terms associated with the reproductive system		
P2. Identify organs and major functions of the male reproductive system		
P3. Identify organs and major functions of the female reproductive system		
P4. Describe the reproductive process		
Q1. Demonstrate good communication skills		
Q2. Maintain confidentiality		
Q3. Report/record pertinent information to appropriate personnel		
Q4. Make and receive telephone calls		
Q5. Utilize care plan		

HEALTH SERVICES ASSISTANT		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
Q6. Answer patient's call light		
R1. Use appropriate body mechanics		
R2. Maintain safe environment for resident and self		
R3. Wash hands		
R4. Describe emergency procedures to follow for fire, natural disaster		
R5. Describe emergency procedures to follow for cuts/falls/seizures		
S1. Weigh and measure	Computation • Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Estimation • Use estimation strategies and mental computation to determine if an answer is reasonable (8C-2)	R
	Measurement • Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Convert units of measure within a system (6D-9)	R
	Graphing and Statistics • Construct, read, and interpret displays of data (7F-2)	R
S2. Check urine using acetest		
S3. Check urine using keto-diastik		
S4. Check urine using test tape		

HEALTH SERVICES ASSISTANT		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
T2. Measure and record axillary temperature	Estimation Use estimation strategies and mental computation to determine if an answer is reasonable (8C-2)	R
	Measurement Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Graphing and Statistics Systematically collect, organize, and classify data (7F-1)	R
	Construct, read, and interpret displays of data (7F-2)	R
T3. Measure and record blood pressure	Estimation Use estimation strategies and mental computation to determine if an answer is reasonable (8C-2)	R
	Measurement Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Graphing and Statistics Systematically collect, organize, and classify data (7F-1)	R
	Construct, read, and interpret displays of data (7F-2)	R

HEALTH SERVICES ASSISTANT		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
T4. Measure and record oral temperature	Estimation Use estimation strategies and mental computation to determine if an answer is reasonable (8C-2)	R
	Measurement Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Graphing and Statistics Systematically collect, organize, and classify data (7F-1)	R
	Construct, read, and interpret displays of data (7F-2)	R
T5. Measure and record rectal temperature	Estimation Use estimation strategies and mental computation to determine if an answer is reasonable (8C-2)	R
	Measurement Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Graphing and Statistics Systematically collect, organize, and classify data (7F-1)	R
	Construct, read, and interpret displays of data (7F-2)	R

HEALTH SERVICES ASSISTANT		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
T6. Count and record respirations	Estimation Use estimation strategies and mental computation to determine if an answer is reasonable (8C-2)	R
	Measurement Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Graphing and Statistics Systematically collect, organize, and classify data (7F-1)	R
	Construct, read, and interpret displays of data (7F-2)	R
U1. Prepare patient for a meal		
U2. Assist adult with feeding		
U3. Feed with bulb syringe	Estimation Use estimation strategies and mental computation to determine if an answer is reasonable (8C-2)	R
U4. Give and remove bed pan		
U5. Give and remove urinal		
U6. Give catheter care		
U7. Assist patient to bathroom		

HEALTH SERVICES ASSISTANT		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
V1. Incorporate acceptable techniques when caring for the confused resident		
V2. Make an unoccupied bed		
V3. Make an occupied bed		
V4. Administer complete bed bath	Measurement Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
V5. Administer partial bed bath	Measurement Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
V6. Administer perineal care	Measurement Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
V7. Administer tub bath	Measurement Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
V8. Administer shower bath	Measurement Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
V9. Brush, braid and/or comb hair		
V10. Shampoo hair		
V11. Shave resident		
V12. Give fingernail/toenail care		

HEALTH SERVICES ASSISTANT		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
V13. Perform oral hygiene for the conscious resident		
V14. Perform oral hygiene for the paralyzed resident		
V15. Perform oral hygiene for the unconscious resident		
V16. Clean dentures		
V17. Clean the incontinent resident		
V18. Turn resident in bed		
V19. Give backrub		
V20. Dress and undress resident		
V21. Identify safety/comfort measures for resident receiving oxygen therapy	Measurement Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
W1. Position resident on side from back lying position		
W2. Position resident in prone position		
W3. Assist/raise resident's head and shoulders from the bed		
W4. Lift resident in bed		
W5. Assist patient to ambulate		
W6. Assist patient in and out of wheelchair		
W7. Assist with active range of motion exercises		
W8. Transport patient in wheelchair		
X1. Apply ice bag, cap, pack or collar		

HEALTH SERVICES ASSISTANT		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
X2. Apply local heat using compresses		
X3. Apply heat lamp		
X4. Give decubitus ulcer care		
Y1. Demonstrate an understanding of VICA, its structure and activities		
Y2. Demonstrate an understanding of one's personal values		
Y3. Perform tasks related to effective personal management skills		
Y4. Demonstrate interpersonal skills		
Y5. Demonstrate etiquette and courtesy		
Y6. Demonstrate effectiveness in oral and written communications		
Y7. Develop and maintain code of professional ethics		
Y8. Maintain a good professional appearance		
Y9. Perform basic tasks related to securing and terminating employment		
Y10. Perform basic parliamentary procedures in a group meeting		
Z1. Define terminology associated with death and dying		
Z2. Identify factors affecting attitudes about death		
Z3. List five stages of dying		

HEALTH SERVICES ASSISTANT		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
Z4. Recognize psychological/spiritual/physical needs of the dying resident and appropriate nursing measures		
Z5. Identify physical charges associated with the dying process and signs of imminent death		
Z6. Identify steps in care of the body after death		

APPENDIX:
Additional Math Skills Information

Based on
1990 Core Competencies And Key Skills
For Missouri Schools

Mathematics
Grade 2-10

GRADE LEVEL 2	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
2	2 Compare whole numbers 3 Identify place value a the digit in the ones', tens', or hundreds' place b the place value of a given digit by name c the value of a digit in the ones', tens', or hundreds' place 4 Complete and create patterns a number b geometric c graphic 6 Identify fractional parts	2 Add whole numbers 3 Subtract whole numbers 7 Explore the use of open sentences to describe mathematical relationships a involving addition b involving subtraction c which represent given computational situations		3 Tell and record time	1 Describe, model, draw, and classify shapes a rectangles and squares b circles c triangles	2 Construct, read, and interpret displays of data a bar graphs b pictographs c other displays of data		2 Solve word problems involving addition 3 Solve word problems involving subtraction

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GRADE LEVEL 3	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
3	2 Compare numbers a compare two numbers using < or > b order a set of numbers by magnitude 3 Identify place value a the digit in the ones', tens', hundreds', or thousands' place b the place value of a given digit by name c the value of a digit in the ones', tens', hundreds', or thousands' place 6 Identify fractional parts	4 Add and subtract whole numbers with regrouping 5 Multiply whole numbers 7 Explore the use of open sentences to describe mathematical relationships a involving addition b involving subtraction c involving multiplication and division d identify open sentences that represent given computational situations		3 Tell and record time a relate various recording conventions to each other 5 Measure length, weight (mass), volume, and capacity using nonstandard and standard units a nearest inch b nearest centimeter c nearest pound or kilogram d nearest cup, pint, quart, gallon, and liter	2 Identify cones, cylinders, spheres, pyramids, and cubes	2 Construct, read, and interpret displays of data a read bar graphs and pictographs b contrast displays of data c interpret displays of data 3 Locate points on a grid		2 Solve word problems involving addition and subtraction of money 4 Solve word problems using addition, subtraction, and multiplication

GRADE LEVEL 4	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
4	3 Identify place value a the digit in the ones', tens', hundreds', thousands', or ten thousands' place b the place value of a given digit by name through ten thousands c the value of a specified digit(s) through the ten thousands' place 6 Graph points representing fractions on a number line a select the fraction represented by a given point on a number line b select the point on a number line representing a given fraction	4 Add and subtract whole numbers with up to four addends 5 Multiply whole numbers (3-digit by 1-digit) 7 Use open sentences to express mathematical relationships a identify the open sentence which represents a computational situation involving addition and/or subtraction, and multiplication and/or division b identify the computational situation which represents an open sentence involving addition and/or subtraction and multiplication and/or division	3 Recognize a situation in which an estimate or an exact answer is appropriate	2 Estimate measurements including area and perimeter of regular and irregular regions 5 Measure lengths a to the nearest half inch b to the nearest centimeter	2 Explore properties of right angles	2 Construct, read, and interpret displays of data a select bar graphs and pictographs b contrast displays of data		2 Solve problems involving money management a with computational algorithms b which may require nonstandard strategies 4 Solve standard multi-step word problems, using one or more than one operation 5 Solve nonstandard word problems

GRADE LEVEL 5	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
5	2 Compare unit fractions a compare two fractions using $<$ or $>$ b order a set of fractions by magnitude 3 Compare decimals a compare two decimals using $<$, $>$, or $=$ b order a set of decimals by magnitude 7 Apply number theory concepts a factors b multiples	5 Multiply and divide whole numbers (3-digit by 2-digit) 7 Solve number sentences a involving addition and subtraction with whole numbers and/or decimals b involving multiplication and division with whole numbers with 1-digit multipliers and divisors 8 Add and subtract like fractions	2 Use estimation strategies and mental computation to determine whether an answer is reasonable	2 Estimate measurements a linear measure b area, mass, and volume measures 6 Measure area and perimeter of regular and irregular regions using nonstandard and standard units 9 Convert units of measure within a system a metric system b English system	1 Identify properties of lines a intersecting, parallel, and perpendicular lines b vertical, horizontal, and diagonal (oblique) lines 4 Compare and classify geometric shapes and solids a similar figures b congruent figures c identify a figure with a specified number of lines of symmetry d regular polygons e right triangles	1 Systematically collect, organize, and describe data a best method for collecting data b accurate organization of given data c describe data using ratio and proportion 2 Construct, read, and interpret displays of data a identify graphs that accurately represent given data b interpret displays of data c construct displays of data		4 Solve standard multi-step word problems 5 Solve nonstandard word problems

GRADE LEVEL 6	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
6	2 Compare fractions and decimals a compare two fractions using $<$, $>$, or $=$ b compare two decimals using $<$, $>$, or $=$ c order a set of fractions or decimals by magnitude 4 Compare a numerical sequence 6 Graph points representing positive rational numbers on a number line a select the fraction or decimal represented by a given point b select the point representing a given fraction or decimal	6 Add, subtract, multiply, and divide whole numbers 7 Solve number sentences a involving whole numbers and decimals b involving whole numbers and like fractions 8 Multiply fractions a whole numbers and fractions b fractions with denominators less than 10 9 Use operations in the correct order		1 Choose an appropriate unit of measure and the corresponding tool for a given situation a within the metric system b within the English system 6 Calculate areas and perimeters a of squares and rectangles 9 Convert units of measure within a system a metric system b English system	4 Compare and classify geometric shapes and solids a similar figures b congruent figures c identify a figure with a specified number of lines of symmetry d regular polygons e right triangles	1 Systematically collect, organize, and describe data a best method for collecting data b accurate organization of given data 2 Construct, read, and interpret displays of data a identify graphs that accurately represent given data b interpret displays of data c construct displays of data		1 Solve word problems involving money 4 Solve standard multi-step word problems 5 Solve nonstandard word problems

GRADE LEVEL 7	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
7	1 Communicate and interpret numbers a interpret calculator displays b express numbers in scientific notation with positive exponents c express large numbers in conventional notation 2 Compare positive rational numbers a compare fraction to fraction b compare decimal to fraction 5 Use numerical relationships to describe and simplify numerical situations 7 Apply number theory concepts a classify numbers as prime or composite b factors c multiples d multiple classifications	1 Recall fraction/decimal/percent equivalents 7 Solve linear equations (number sentences) a one-step b two-step 8 Compute the sum, difference, product, or quotient of fractions 9 Use operations in correct order a with + and/or - and + b with + and/or - and x 12 Compute solutions of problems involving percents a calculate percent of a number b calculate percent one number is of another c calculate the whole when a percent is given	1 Determine a reasonable estimate 2 Use estimation strategies and mental computation to determine if an answer is reasonable 5 Solve problems utilizing estimation a utilizing percents b utilizing fractions c utilizing decimals	1 Choose the appropriate unit of precision for a given measurement situation a in metric measurements b in standard measurements 2 Estimate measurement 6 Approximate and/or calculate areas and perimeters of irregularly shaped regions 10 Investigate the relationships among circumference, area, and diameter of a circle 11 Solve problems involving measurement	1 Recognize properties and relationships of lines and angles 2 Classify polygons a classify regular polygons with five or more sides b classify irregular polygons with five or more sides c classify quadrilaterals 3 Determine lines of symmetry in natural and geometric figures a in a natural figure b in a plane geometric figure 5 Identify the plane geometric figures which form the surfaces of three dimensional projects	1 Systematically collect, organize, and classify data a collect and organize statistical data b describe the most appropriate measure c determine mean d determine median e determine mode f determine range 2 Construct, read, and interpret displays of data a construct graphic data displays b identify correctly constructed bar and line graphs, pie charts, pictographs, and scattergrams c interpret bar and line graphs, pie charts, pictographs, and scattergrams 3 Formulate and solve problems that involve collecting and analyzing data	1 Create a problem to illustrate a given numerical sentence 2 Write a number sentence to illustrate a problem 3 Identify unnecessary or missing numerical data in a word problem	2 Solve problems involving percent in consumer situations a sales tax b discount c commission 4 Solve problems using ratio and proportion in consumer situations a involving pricing b involving recipe conversion c involving medication dosage d involving relative distances between locations

GRADE LEVEL 8	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
8	1 Communicate and interpret numbers a convert rational numbers to scientific notation b convert scientific notation to rational numbers 2 Compare rational numbers a compare fraction to fraction b compare decimal to fraction 5 Use mathematical relationships to describe and simplify mathematical expressions 7 Apply number theory a determine powers b determine square roots c determine cube roots	6 Compute the sum, difference, product, or quotient of integers 7 Solve linear equations a one-step b two-step 9 Evaluate algebraic expressions, given values for the variables	2 Use estimation strategies and mental computation to determine if an answer is reasonable 5 Solve problems utilizing estimation a utilizing percents b utilizing fractions c utilizing decimals	2 Estimate measurement 6 Calculate the perimeter or the area of a triangle, rectangle, or square 10 Calculate the circumference or the area of a circle 11 Solve problems involving measurement	1 Recognize properties and relationships of lines and angles a identify bisectors b identify radii c identify diagonals d identify diameters e identify interior angles f identify exterior angles 2 Classify polygons a classify triangles by sides/angles b classify quadrilaterals (e.g., parallelogram, rectangle, rhombus, trapezoid) 3 Recognize similar and congruent figures 5 Visualize, draw, and construct geometric figures	3 Formulate and solve problems that involve collecting and analyzing data 4 Calculate and interpret the probability of an event	1 Create a word problem to illustrate a given equation, or write an equation to illustrate a given problem 4 Follow a series of instructions in sequential order a in a flow chart b in a diagram c in a narrative	1 Solve problems involving money in consumer situations a involving simple interest b involving total cost of installment purchases c involving total cost of purchases including sales tax d involving discounts e involving sale prices 3 Solve problems involving area and perimeter in consumer situations 4 Solve problems using proportion in consumer situations a involving pricing b involving recipe conversion c involving medication dosage d involving relative distances between locations

GRADE LEVEL 9	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
9	5 Use mathematical relationships to simplify expressions a mathematical expressions b algebraic expressions 7 Apply number theory concepts	2 Compute using scientific notation 7 Solve linear equations a one/two steps with integral coefficients and integral or rational solutions	2 Judge reasonableness of solutions or estimates of solutions to problems 4 Determine the relative magnitude of fractional numbers 5 Solve problems utilizing estimation a consumer situations b practical situations	5 Compute the area and perimeter of irregularly shaped figures 11 Solve problems involving measurement a volume of cylinders b volume of rectangular solids	1 Recognize properties and relationships of lines and angles 4 Determine if a given point is on the graph of a given equation 5 Visualize, draw, and construct geometric figures 6 Solve problems using measures of inclination: (slope)	2 Calculate and interpret the probability of an event 3 Formulate and solve problems that involve collecting and analyzing statistical data a draw inferences b evaluate conclusions c solve problems involving mean, median, mode, and range 4 Judge the reliability of inferences drawn from statistical data	1 Translate word phrases and sentences into algebraic expressions and equations 2 Evaluate the validity of conclusions drawn from given premises and definitions 3 Identify impediments to solving a given problem a information to solve a problem b information missing to solve a problem c information unnecessary to solve a problem d information that needs to be converted to another form	1 Solve problems involving volume and area in consumer situations 2 Solve problems using proportion in consumer situations a involving pricing b involving food, recipes, and nutrition c involving medication dosage d involving relative distances between locations 3 Investigate problems involving personal finance 4 Compute gross pay using hourly, monthly, commission, piecework, and/or overtime rates

GRADE LEVEL 10	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
10	5 Use mathematical relationships to simplify expressions a mathematical expressions b algebraic expressions	7 Solve linear equations a with decimal coefficients b with fractional coefficients c with integral coefficients 10 Solve formulas for a given variable	1 Estimate solutions for various computational problems a using scientific notation b using whole numbers c using fractions d using decimals 2 Judge reasonableness of solutions 5 Solve problems utilizing estimation a on consumer situations b on practical situations	5 Solve problems requiring the application of the Pythagorean theorem a given diagrams and measurements of right triangles b given a situation involving a right triangle 11 Solve problems involving measurement	1 Recognize properties and relationships of lines and angles a parallel and perpendicular lines b complementary and supplementary angles c alternate interior and corresponding angles d calculate the third angle of a triangle 3 Graph equations a plot the graph of a linear equation b identify the graph of a linear equation c identify the slope of a line given its graph and equation d use the graph of a line to identify its equation 5 Visualize, draw, and construct geometric figures 6 Solve problems using the concepts of symmetry, similarity, and congruence a determine lines of symmetry b use the concept of congruence	2 Calculate and interpret the probability of an event 3 Identify limitations of an inference drawn from statistical data a limitations to an inference b additional information needed c demonstrable bias	1 State logical conclusions from given conditions 2 Evaluate the acceptability of a conclusion drawn through logical inference	2 Solve banking problems related to maintaining a checking account 4 Use appropriate information and tables to compute net pay, considering Social Security deductions, state and federal taxes, etc.

INTEGRATING VOCATIONAL COMPETENCIES AND MATH SKILLS

MACHINE TECHNOLOGY

Available from the
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FOREWORD

National interest and legislation support the need for identifying core competencies and key skills taught in industrial education classes. An understanding of the basic competencies involved will help identify academic subjects as they relate to specific occupations.

The following program area/math skills matrix can therefore be a valuable resource for program integration of academics, pre-testing and skills assessment, and special needs curriculum development. It identifies the math core competencies and key skills required for/taught in one of ten program areas at the Missouri secondary level. Matrices were developed for: Air Conditioning, Heating, and Refrigeration; Auto Collision Technology; Automotive Technology; Building Trades; Drafting; Electronics; Graphic Arts (Offset Lithography); Health Services Assistant; Machine Technology; and Welding.

The materials used to create the matrix include: the 1990 Core Competencies and Key Skills for Missouri Schools, grades two through ten; and Instructional Materials Laboratory vocational program competency profiles for the program areas involved.

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TO THE INSTRUCTOR: SUGGESTIONS FOR USE

The matrix that follows is divided into three columns. Reading in a row across all three of the columns will identify which math skills are involved in each vocational competency and tell whether the math skills are new to students or simply need reinforcement.

The first column identifies the vocational competencies involved in the program area. The numbers and competencies in this column refer to the Instructional Materials Laboratory competency profile for the program area.

The second column identifies which math skills are involved in the vocational competencies. The skills and numbers listed in this column refer to the 1990 Core Competencies and Key Skills for Missouri Schools, grades two through ten. (The list can also stand alone as a general list of math skills.) The column is blank for any vocational competency that the committee members decided did not require math skills.

Additional information about the math skills listed in the second column of the matrix may be found in the appendix following the matrix. The appendix is based on the math skills identified in the 1990 Core Competencies and Key Skills for Missouri Schools.

The last column tells whether the math skills will be new to students in the vocational classroom or whether they have been covered by math courses in the second through tenth grades. You may want to review and/or reinforce the math skills that students already have, and to make arrangements for them to learn the skills that are new to them.

As you use the matrix to help students learn or review math skills, keep in mind that different students learn in different ways. Efforts should be made to ensure that all students have an equal opportunity to understand and learn the material, regardless of race, color, national origin, gender, age, or disability.

Hold high expectations for all students, and provide the instruction necessary for students to meet those expectations. It is important that students achieve in math because research has shown a link between attitude toward mathematics and science, self-esteem levels, and career aspirations. According to a survey by the American Association of University Women: "Girls and boys who like mathematics and science have higher self-esteem, more ambitious career goals, and are more likely to hold onto their dreams."

As you help students achieve and develop this positive attitude toward mathematics, be aware that students of different genders give different reasons for their lack of interest in math. The AAUW survey states: "The gender differences in the intertwining of self-esteem and math/science interest is most evident in girls' and boys' reasons for their declining interest in math and science. While boys 'externalize' by seeing math and science as unimportant, girls 'internalize' by thinking themselves not smart enough."

MACHINE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
A1. Operate safely in the workshop		
A2. List machine shop safety rules and regulations		
A3. Identify characteristics of a machinist		
A4. Inspect work area for safe work environment		
B1. Convert common fraction to decimal fraction and vice versa	Understanding Numbers Compare positive rational numbers (7A-2)	R
	Computation Recall fraction/decimal/percent equivalents (7B-1)	R
B2. Calculate tap drill size with formula and charts	Computation Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Graphing and Statistics Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving - Identify unnecessary or missing numerical data in a word problem (7G-3) - Follow a series of instructions in sequential order (8G-4)	R

MACHINE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
B3. Convert customary measurements to metric and vice versa	Computation Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Consumer Problems Solve problems using ratio and proportion in consumer situations (7H-4)	R
B4. Use calculator to perform mathematical operations	Estimation Estimate solutions for various computational problems (10C-1)	R
B5. Calculate amount of stock required	Computation Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Problem Solving Identify unnecessary or missing numerical data in a word problem (7G-3)	R
	Identify impediments to solving a given problem (9G-3)	R

MACHINE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
B6. Calculate part and feature dimensions and locations	Computation • Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Problem Solving • Identify unnecessary or missing numerical data in a word problem (7G-3)	R
	• Identify impediments to solving a given problem (9G-3)	R
B7. Convert revolutions per minute (RPM) to surface feet per minute (SFPM)	Computation • Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	• Use operations in the correct order (6B-9)	R
	• Solve formulas for a given variable (10B-10)	R
	Measurement • Calculate the circumference or the area of a circle (8D-10)	R
	Problem Solving • Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R
	Consumer Problems • Solve problems using ratio and proportion in consumer situations (7H-4)	R

MACHINE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
B8. Calculate feeds and speeds	Computation	
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	• Use operations in the correct order (6B-9)	R
	• Solve formulas for a given variable (10B-10)	R
	Measurement	
	• Calculate the circumference or the area of a circle (8D-10)	R
	Problem Solving	
	• Identify impediments to solving a given problem (9G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R
	Consumer Problems	
	• Solve problems using ratio and proportion in consumer situations (7H-4)	R

MACHINE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
B9. Calculate tapers for machine set-up	Computation	R
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	• Use operations in the correct order (6B-9)	R
	• Solve formulas for a given variable (10B-10)	R
B10. Calculate sine bar set-up	Geometry	R
	• Recognize properties and relationships of lines and angles (7E-1)	R
	Graphing and Statistics	R
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	R
	• Identify impediments to solving a given problem (9G-3)	R
	Computation	R
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	• Solve formulas for a given variable (10B-10)	R
	Graphing and Statistics	R
	• Construct, read, and interpret displays of data (7F-2)	R

MACHINE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
B11. Perform angular and simple indexing calculations	Measurement Calculate the circumference or the area of a circle (8D-10)	R
	Graphing and Statistics Construct, read, and interpret displays of data (7F-2)	R
	Consumer Problems Solve problems using ratio and proportion in consumer situations (7H-4)	R
B12. Calculate measurements of right triangles	Computation Add, subtract, multiply and divide decimals and divide whole numbers (6B-6)	R
	Measurement Solve problems requiring the application of the Pythagorean theorem (10D-5)	R
	Graphing and Statistics Construct, read, and interpret displays of data (7F-2)	R

MACHINE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
B13. Calculate plane geometry/math applications	Computation	
	• Add, subtract, multiply and divide decimals and divide whole numbers (6B-6)	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement	
	• Solve problems requiring the application of the Pythagorean theorem (10D-5)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
C1. Care for precision instruments		
C2. Measure workpiece with tape measure	Computation	
	• Add, subtract, multiply and divide decimals and divide whole numbers (6B-6)	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R

MACHINE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
C3. Measure workpiece with pocket rule	Computation	
	• Add, subtract, multiply and divide decimals and divide whole numbers (6B-6)	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R
C4. Measure workpiece with slide caliper rule	Computation	
	• Add, subtract, multiply and divide decimals and divide whole numbers (6B-6)	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R

MACHINE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
C5. Lay out work with combination square	Computation	
	• Add, subtract, multiply and divide decimals and divide whole numbers (6B-6)	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
C6. Transfer measurement with dividers	• Estimate measurement (8D-2)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R
	• Visualize, draw, and construct geometric figures (8E-5)	R
	Computation	
C6. Transfer measurement with dividers	• Add, subtract, multiply and divide decimals and divide whole numbers (6B-6)	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R

MACHINE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
C7. Lay out workpiece with hermaphrodite calipers	Computation	
	• Add, subtract, multiply and divide decimals and divide whole numbers (6B-6)	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R
C8. Measure workpiece with spring calipers	Computation	
	• Add, subtract, multiply and divide decimals and divide whole numbers (6B-6)	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R

MACHINE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
C9. Measure workpiece with vernier calipers	Computation Add, subtract, multiply and divide decimals and divide whole numbers (6B-6)	R
	Measurement Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Estimate measurement (8D-2)	R
C10. Measure workpiece with depth gages	Computation Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Measurement Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Estimate measurement (8D-2)	R
C11. Measure workpiece with micrometers	Computation Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Measurement Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Estimate measurement (8D-2)	R

MACHINE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
C12. Measure workpiece with dial calipers	Understanding Numbers Compare positive rational numbers (7A-2)	R
	Computation Recall fraction/decimal/percent equivalents (7B-1)	R
	Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Measurement Estimate measurement (8D-2)	R
C13. Measure workpiece with telescoping and small hole gages	Computation Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Measurement Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Estimate measurement (8D-2)	R
C14. Check work with gages, i.e., plug and ring gages	Computation Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Measurement Choose the appropriate unit of precision for a given measurement situation (7D-1)	R

MACHINE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
C15. Measure workpiece with height gages	Computation Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Measurement Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Estimate measurement (8D-2)	R
C16. Lay out workpiece and measure on surface plate	Computation Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Estimate measurement (8D-2)	R
	Geometry Recognize properties and relationships of lines and angles (7E-1)	R
	Visualize, draw, and construct geometric figures (8E-5)	R

MACHINE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
C17. Measure workpiece on surface plate	Computation Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Measurement Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Estimate measurement (8D-2)	R
C18. Measure workpiece with gage blocks	Computation Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Measurement Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Estimate measurement (8D-2)	R
C19. Measure workpiece with dial indicators and attachments	Computation Recall fraction/decimal/percent equivalents (7B-1)	R
	Measurement Choose the appropriate unit of precision for a given measurement situation (7D-1)	R

MACHINE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
C20. Measure workpiece with thread wires and micrometers	Computation	R
	• Use operations in the correct order (6B-9)	R
	• Solve formulas for a given variable (10B-10)	R
	Measurement	R
C21. Check and/or lay out workpiece with sine bar	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Problem Solving	R
	• Identify impediments to solving a given problem (9G-3)	R
	Computation	R
D1. Interpret meaning of common drafting symbols	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	• Solve formulas for a given variable (10B-10)	R
	Graphing and Statistics	R
	• Construct, read, and interpret displays of data (7F-2)	R

MACHINE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
E5. Locate holes with transfer screws and transfer punches	Understanding Numbers Compare positive rational numbers (7A-2)	R
	Computation Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Estimate measurement (8D-2)	R
E6. Cut threads with die	Understanding Numbers Compare positive rational numbers (7A-2)	R
	Computation Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Estimate measurement (8D-2)	R

MACHINE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
E7. Cut threads with hand tap	Understanding Numbers	
	• Compare positive rational numbers (7A-2)	R
	Computation	
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
E8. Ream holes with hand reamer	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R
	Understanding Numbers	
	• Compare positive rational numbers (7A-2)	R
E9. Dress and true grinding wheels on pedestal/bench grinder	Computation	
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R

MACHINE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
E10. Grind and shape tools on pedestal/bench grinder	Measurement Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Geometry Recognize properties and relationships of lines and angles (7E-1)	R
E11. Use abrasives/whetting/polishing/lapping		
E12. Grind using appropriate hand grinder		
E13. Remove damaged screws	Computation Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Geometry Recognize properties and relationships of lines and angles (7E-1)	R
	Problem Solving - Identify unnecessary or missing numerical data in a word problem (7G-3) - Follow a series of instructions in sequential order (8G-4)	R R

MACHINE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
E14. Remove broken drills and taps	Computation	
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R
	Problem Solving	
	• Identify unnecessary or missing numerical data in a word problem (7G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R
E15. Remove and install dowel pins	Understanding Numbers	
	• Compare positive rational numbers (7A-2)	R
	Computation	
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R
E16. Install a helical coil thread insert		

MACHINE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
E17. Straighten workpiece on arbor press	Computation Recall fraction/decimal/percent equivalents (7B-1)	R
	Measurement Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
E18. Assemble and disassemble workpiece with arbor press		
E19. Broach workpiece with broaching tool	Understanding Numbers Compare positive rational numbers (7A-2)	R
	Computation Recall fraction/decimal/percent equivalents (7B-1)	R
	Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Estimate measurement (8D-2)	R
E20. Assemble and disassemble precision parts		
F1. Identify types of metals and related materials		

MACHINE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
F2. List properties that affect machinability		
F3. Correlate types of materials to their properties		
F4. List major cutting tool variables		
F5. Perform heat treatment process		
F6. Test workpiece for hardness without hardness tester		
G1. Employ power saw safety guidelines consistently		
G2. Perform care and maintenance		
G3. Select proper blade type for sawing operations and materials	Graphing and Statistics Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving Identify impediments to solving a given problem (9G-3)	R
G4. Cut and weld band saw blades	Computation Solve formulas for a given variable (10B-10)	R
	Measurement Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Geometry Recognize properties and relationships of lines and angles (7E-1)	R

MACHINE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
G5. Select and set speeds and feeds on power saw	Computation Solve formulas for a given variable (10B-10)	R
	Graphing and Statistics Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving Identify impediments to solving a given problem (9G-3)	R
G6. Cut material to length with power hack saw	Computation Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Estimate measurement (8D-2)	R

MACHINE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
H5. Determine cutting tool variables prior to use	Geometry Recognize properties and relationships of lines and angles (7E-1)	R
	Problem Solving Identify impediments to solving a given problem (9G-3)	R
H6. Set up drill press to obtain calculated feeds and speeds	Computation Solve formulas for a given variable (10B-10)	R
	Graphing and Statistics Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving Identify impediments to solving a given problem (9G-3)	R
H7. Select and apply cutting fluids	Consumer Problems Solve problems using ratio and proportion in consumer situations (7H-4)	R

MACHINE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
H8. Drill holes to specification using manual feed	Computation	
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement	
H9. Drill holes to specification using automatic feed	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R
	Computation	
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R

MACHINE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
H10. Counter sink hole to specifications	Understanding Numbers Compare positive rational numbers (7A-2)	R
	Computation Recall fraction/decimal/percent equivalents (7B-1)	R
	Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Estimate measurement (8D-2)	R

MACHINE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
H11. Counter bore hole to specifications	Understanding Numbers	R
	• Compare positive rational numbers (7A-2)	
	Computation	R
	• Recall fraction/decimal/percent equivalents (7B-1)	
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
H12. Spotface to specific dimensions	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R
H13. Mount workpiece on V-blocks	Computation	
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R

MACHINE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
H14. Power ream hole to size	Understanding Numbers	
	• Compare positive rational numbers (7A-2)	R
	Computation	
	• Recall fraction/decimal/percent equivalents (7B-1)	R
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	• Solve formulas for a given variable (10B-10)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Identify impediments to solving a given problem (9G-3)	R

MACHINE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
H15. Use drill jigs and bushings	Computation	
	Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement	
	Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Estimate measurement (8D-2)	R
H16. Hand tap hole using drill press	Computation	
	Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Graphing and Statistics	
	Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	Identify unnecessary or missing numerical data in a word problem (7G-3)	R
	Follow a series of instructions in sequential order (8G-4)	R

MACHINE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
H17. Tap hole with tapping attachments	Computation	
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Identify unnecessary or missing numerical data in a word problem (7G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R
H18. Sharpen drills with grinding attachments and/or specialized grinders	Computation	
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R

MACHINE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
17. Select and apply cutting fluids	Consumer Problems Solve problems using ratio and proportion in consumer situations (7H-4)	R
18. Operate lathe controls	Measurement Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
19. Face workpiece and center drill	Computation Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Estimate measurement (8D-2)	R

MACHINE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
110. Set up tooling	Computation	
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R
111. Turn workpiece between centers	Computation	
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R
	• Visualize, draw, and construct geometric figures (8E-5)	R

MACHINE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
114. Ream holes	Understanding Numbers	
	• Compare positive rational numbers (7A-2)	R
	Computation	
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
115. Bore holes	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R
	Understanding Numbers	
	• Compare positive rational numbers (7A-2)	R
	Computation	
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R

MACHINE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
I16. Countersink holes	Understanding Numbers Compare positive rational numbers (7A-2)	R
	Computation Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Estimate measurement (8D-2)	R
I17. Counterbore holes	Understanding Numbers Compare positive rational numbers (7A-2)	R
	Computation Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Estimate measurement (8D-2)	R

MACHINE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
I18. Knurl parts	Computation	
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R
I19. Free-hand grind 60 degree threading tool	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R

MACHINE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
I20. Cut/chase external threads	Computation	
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	• Solve formulas for a given variable (10B-10)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Identify impediments to solving a given problem (9G-3)	R

MACHINE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
I21. Chase/rechase internal threads	Computation - Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6) - Compute the sum, difference, product, or quotient of fractions (7B-8) - Solve formulas for a given variable (10B-10) Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) Graphing and Statistics - Construct, read, and interpret displays of data (7F-2) Problem Solving - Identify impediments to solving a given problem (9G-3)	R R R R R R

MACHINE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
I22. Chase metric threads	Computation	R
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	• Solve formulas for a given variable (10B-10)	R
	Measurement	R
I23. Use compound rest to cut short external tapered surface	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Graphing and Statistics	R
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	R
	• Identify impediments to solving a given problem (9G-3)	R
	Measurement	R
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Geometry	R
	• Recognize properties and relationships of lines and angles (7E-1)	R

MACHINE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
I24. Cut tapers by offset tailstock	Computation	
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	• Use operations in the correct order (6B-9)	R
	• Solve formulas for a given variable (10B-10)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Identify impediments to solving a given problem (9G-3)	R

MACHINE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
I25. Cut an external tapered surface with taper attachment	Computation	
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	• Use operations in the correct order (6B-9)	R
	• Solve formulas for a given variable (10B-10)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Identify impediments to solving a given problem (9G-3)	R

MACHINE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
I30. Turn or thread long workpieces using follower and steady rest	Computation	
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	• Solve formulas for a given variable (10B-10)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Identify impediments to solving a given problem (9G-3)	R

MACHINE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
I33. Use form tooling	Computation	
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement	
I34. Use mandrel	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R
I34. Use mandrel	Computation	
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R

MACHINE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
J9. Square workpiece using table vise	Understanding Numbers	
	• Compare positive rational numbers (7A-2)	R
	Computation	
	• Recall fraction/decimal/percent equivalents (7B-1)	R
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R

MACHINE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
J10. Mill workpiece with end mill	Understanding Numbers	
	• Compare positive rational numbers (7A-2)	R
	Computation	
	• Recall fraction/decimal/percent equivalents (7B-1)	R
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R
J11. Locate work with edge finder	Computation	
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R

MACHINE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
J12. Drill holes with milling machine	Computation - Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6) - Compute the sum, difference, product, or quotient of fractions (7B-8) Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Estimate measurement (8D-2) Geometry - Recognize properties and relationships of lines and angles (7E-1)	R R R R R
J13. Ream holes	Computation - Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6) - Compute the sum, difference, product, or quotient of fractions (7B-8) Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Estimate measurement (8D-2) Geometry - Recognize properties and relationships of lines and angles (7E-1)	R R R R R

MACHINE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
J19. Mill angular surfaces	Computation - Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6) - Compute the sum, difference, product, or quotient of fractions (7B-8) Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Solve problems requiring the application of the Pythagorean theorem (10D-5) Geometry - Recognize properties and relationships of lines and angles (7E-1) Graphing and Statistics - Construct, read, and interpret displays of data (7F-2)	R R R R R

MACHINE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
J20. Mill an external radius with rotary table	Computation	
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems requiring the application of the Pythagorean theorem (10D-5)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R

MACHINE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
J21. Mill an internal radius with rotary table	Computation	R
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	
	Measurement	R
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems requiring the application of the Pythagorean theorem (10D-5)	
J22. Mill workpiece using simple indexing operation	Geometry	R
	• Recognize properties and relationships of lines and angles (7E-1)	
	Graphing and Statistics	R
	• Construct, read, and interpret displays of data (7F-2)	
	Measurement	R
	• Calculate the circumference or the area of a circle (8D-10)	
	Graphing and Statistics	R
	• Construct, read, and interpret displays of data (7F-2)	
	Consumer Problems	R
	• Solve problems using ratio and proportion in consumer situations (7H-4)	

MACHINE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
J23. Use digital readout	Computation Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Geometry Graph equations (10E-3)	R
J24. Machine workpiece by straddle milling	Understanding Numbers Compare positive rational numbers (7A-2)	R
	Computation Recall fraction/decimal/percent equivalents (7B-1)	R
	Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Estimate measurement (8D-2)	R

MACHINE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
K3. Select and apply cutting fluids	Consumer Problems Solve problems using ratio and proportion in consumer situations (7H-4)	R
K4. Inspect grinding wheel		
K5. Balance grinding wheel		
K6. Select and mount grinding wheel	Graphing and Statistics Construct, read, and interpret displays of data (7F-2)	R
K7. Dress and true machine tool grinding wheel		
K8. Grind workpiece on magnetic chuck using power feed	Computation Recall fraction/decimal/percent equivalents (7B-1)	R
	Measurement Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Estimate measurement (8D-2)	R

MACHINE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
K9. Grind workpiece square on surface grinder	Computation	
	• Recall fraction/decimal/percent equivalents (7B-1)	R
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
K10. Indicate workpiece to be ground	• Estimate measurement (8D-2)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R
	• Visualize, draw, and construct geometric figures (8E-5)	R
K10. Indicate workpiece to be ground	Computation	
	• Recall fraction/decimal/percent equivalents (7B-1)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
K10. Indicate workpiece to be ground	• Estimate measurement (8D-2)	R

MACHINE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
M3. Calculate coordinates and dimensions of CNC drawing	Computation	
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	• Solve formulas for a given variable (10B-10)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems requiring the application of the Pythagorean theorem (10D-5)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R
	• Graph equations (10E-3)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Follow a series of instructions in sequential order (8G-4)	R

MACHINE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
M4. Write program for CNC machine	Computation	
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	• Solve formulas for a given variable (10B-10)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems requiring the application of the Pythagorean theorem (10D-5)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R
	• Graph equations (10E-3)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Follow a series of instructions in sequential order (8G-4)	R

MACHINE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
M5. Set up a CNC machine	Computation	
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	• Solve formulas for a given variable (10B-10)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems requiring the application of the Pythagorean theorem (10D-5)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R
	• Graph equations (10E-3)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Follow a series of instructions in sequential order (8G-4)	R

MACHINE TECHNOLOGY		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
M6. Machine workpiece with CNC machine	Computation	
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	• Solve formulas for a given variable (10B-10)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems requiring the application of the Pythagorean theorem (10D-5)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R
	• Graph equations (10E-3)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Follow a series of instructions in sequential order (8G-4)	R

APPENDIX:
Additional Math Skills Information

Based on
1990 Core Competencies And Key Skills
For Missouri Schools

Mathematics
Grade 2-10

GRADE LEVEL 2	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
2	2 Compare whole numbers 3 Identify place value a the digit in the ones', tens', or hundreds' place b the place value of a given digit by name c the value of a digit in the ones', tens', or hundreds' place 4 Complete and create patterns a number b geometric c graphic 6 Identify fractional parts	2 Add whole numbers 3 Subtract whole numbers 7 Explore the use of open sentences to describe mathematical relationships a involving addition b involving subtraction c which represent given computational situations		3 Tell and record time	1 Describe, model, draw, and classify shapes a rectangles and squares b circles c triangles	2 Construct, read, and interpret displays of data a bar graphs b pictographs c other displays of data		2 Solve word problems involving addition 3 Solve word problems involving subtraction

739

740

GRADE LEVEL 3	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
3	2 Compare numbers a compare two numbers using < or > b order a set of numbers by magnitude 3 Identify place value a the digit in the ones', tens', hundreds', or thousands' place b the place value of a given digit by name c the value of a digit in the ones', tens', hundreds', or thousands' place 6 Identify fractional parts	4 Add and subtract whole numbers with regrouping 5 Multiply whole numbers 7 Explore the use of open sentences to describe mathematical relationships a involving addition b involving subtraction c involving multiplication and division d identify open sentences that represent given computational situations		3 Tell and record time a relate various recording conventions to each other 5 Measure length, weight (mass), volume, and capacity using nonstandard and standard units a nearest inch b nearest centimeter c nearest pound or kilogram d nearest cup, pint, quart, gallon, and liter	2 Identify cones, cylinders, spheres, pyramids, and cubes	2 Construct, read, and interpret displays of data a read bar graphs and pictographs b contrast displays of data c interpret displays of data 3 Locate points on a grid		2 Solve word problems involving addition and subtraction of money 4 Solve word problems using addition, subtraction, and multiplication

741

742

GRADE LEVEL 4	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
4	3 Identify place value a the digit in the ones', tens', hundreds', thousands', or ten thousands' place b the place value of a given digit by name through ten thousands c the value of a specified digit(s) through the ten thousands' place 6 Graph points representing fractions on a number line a select the fraction represented by a given point on a number line b select the point on a number line representing a given fraction	4 Add and subtract whole numbers with up to four addends 5 Multiply whole numbers (3-digit by 1-digit) 7 Use open sentences to express mathematical relationships a identify the open sentence which represents a computational situation involving addition and/or subtraction, and multiplication and/or division b identify the computational situation which represents an open sentence involving addition and/or subtraction and multiplication and/or division	3 Recognize a situation in which an estimate or an exact answer is appropriate	2 Estimate measurements including area and perimeter of regular and irregular regions 5 Measure lengths a to the nearest half inch b to the nearest centimeter	2 Explore properties of right angles	2 Construct, read, and interpret displays of data a select bar graphs and pictographs b contrast displays of data		2 Solve problems involving money management a with computational algorithms b which may require nonstandard strategies 4 Solve standard multi-step word problems, using one or more than one operation 5 Solve nonstandard word problems

GRADE LEVEL 5	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
5	2 Compare unit fractions a compare two fractions using < or > b order a set of fractions by magnitude 3 Compare decimals a compare two decimals using <, >, or = b order a set of decimals by magnitude 7 Apply number theory concepts a factors b multiples	5 Multiply and divide whole numbers (3-digit by 2-digit) 7 Solve number sentences a involving addition and subtraction with whole numbers and/or decimals b involving multiplication and division with whole numbers with 1-digit multipliers and divisors 8 Add and subtract like fractions	2 Use estimation strategies and mental computation to determine whether an answer is reasonable	2 Estimate measurements a linear measure b area, mass, and volume measures 6 Measure area and perimeter of regular and irregular regions using nonstandard and standard units 9 Convert units of measure within a system a metric system b English system	1 Identify properties of lines a intersecting, parallel, and perpendicular lines b vertical, horizontal, and diagonal (oblique) lines 4 Compare and classify geometric shapes and solids a similar figures b congruent figures c identify a figure with a specified number of lines of symmetry d regular polygons e right triangles	1 Systematically collect, organize, and describe data a best method for collecting data b accurate organization of given data c describe data using ratio and proportion 2 Construct, read, and interpret displays of data a identify graphs that accurately represent given data b interpret displays of data c construct displays of data		4 Solve standard multi-step word problems 5 Solve nonstandard word problems

GRADE LEVEL 6	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
6	2 Compare fractions and decimals a compare two fractions using $<$, $>$, or $=$ b compare two decimals using $<$, $>$, or $=$ c order a set of fractions or decimals by magnitude 4 Compare a numerical sequence 6 Graph points representing positive rational numbers on a number line a select the fraction or decimal represented by a given point b select the point representing a given fraction or decimal	6 Add, subtract, multiply, and divide whole numbers 7 Solve number sentences a involving whole numbers and decimals b involving whole numbers and like fractions 8 Multiply fractions a whole numbers and fractions b fractions with denominators less than 10 9 Use operations in the correct order		1 Choose an appropriate unit of measure and the corresponding tool for a given situation a within the metric system b within the English system 6 Calculate areas and perimeters a of squares and rectangles 9 Convert units of measure within a system a metric system b English system	4 Compare and classify geometric shapes and solids a similar figures b congruent figures c identify a figure with a specified number of lines of symmetry d regular polygons e right triangles	1 Systematically collect, organize, and describe data a best method for collecting data b accurate organization of given data 2 Construct, read, and interpret displays of data a identify graphs that accurately represent given data b interpret displays of data c construct displays of data		1 Solve word problems involving money 4 Solve standard multi-step word problems 5 Solve nonstandard word problems

GRADE LEVEL 7	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
7	1 Communicate and interpret numbers a interpret calculator displays b express numbers in scientific notation with positive exponents c express large numbers in conventional notation 2 Compare positive rational numbers a compare fraction to fraction b compare decimal to fraction 5 Use numerical relationships to describe and simplify numerical situations 7 Apply number theory concepts a classify numbers as prime or composite b factors c multiples d multiple classifications	1 Recall fraction/decimal/percent equivalents 7 Solve linear equations (number sentences) a one-step b two-step 8 Compute the sum, difference, product, or quotient of fractions 9 Use operations in correct order a with + and/or - and + b with + and/or - and x 12 Compute solutions of problems involving percents a calculate percent of a number b calculate percent one number is of another c calculate the whole when a percent is given	1 Determine a reasonable estimate 2 Use estimation strategies and mental computation to determine if an answer is reasonable 5 Solve problems utilizing estimation a utilizing percents b utilizing fractions c utilizing decimals	1 Choose the appropriate unit of precision for a given measurement situation a in metric measurements b in standard measurements 2 Estimate measurement 6 Approximate and/or calculate areas and perimeters of irregularly shaped regions 10 Investigate the relationships among circumference, area, and diameter of a circle 11 Solve problems involving measurement	1 Recognize properties and relationships of lines and angles 2 Classify polygons a classify regular polygons with five or more sides b classify irregular polygons with five or more sides c classify quadrilaterals 3 Determine lines of symmetry in natural and geometric figures a in a natural figure b in a plane geometric figure 5 Identify the plane geometric figures which form the surfaces of three dimensional projects	1 Systematically collect, organize, and classify data a collect and organize statistical data b describe the most appropriate measure c determine mean d determine median e determine mode f determine range 2 Construct, read, and interpret displays of data a construct graphic data displays b identify correctly constructed bar and line graphs, pie charts, pictographs, and scattergrams c interpret bar and line graphs, pie charts, pictographs, and scattergrams 3 Formulate and solve problems that involve collecting and analyzing data	1 Create a problem to illustrate a given numerical sentence 2 Write a number sentence to illustrate a problem 3 Identify unnecessary or missing numerical data in a word problem	2 Solve problems involving percent in consumer situations a sales tax b discount c commission 4 Solve problems using ratio and proportion in consumer situations a involving pricing b involving recipe conversion c involving medication dosage d involving relative distances between locations

GRADE LEVEL 8	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
8	1 Communicate and interpret numbers a convert rational numbers to scientific notation b convert scientific notation to rational numbers 2 Compare rational numbers a compare fraction to fraction b compare decimal to fraction 5 Use mathematical relationships to describe and simplify mathematical expressions 7 Apply number theory a determine powers b determine square roots c determine cube roots	6 Compute the sum, difference, product, or quotient of integers 7 Solve linear equations a one-step b two-step 9 Evaluate algebraic expressions, given values for the variables	2 Use estimation strategies and mental computation to determine if an answer is reasonable 5 Solve problems utilizing estimation a utilizing percents b utilizing fractions c utilizing decimals	2 Estimate measurement 6 Calculate the perimeter or the area of a triangle, rectangle, or square 10 Calculate the circumference or the area of a circle 11 Solve problems involving measurement	1 Recognize properties and relationships of lines and angles a identify bisectors b identify radii c identify diagonals d identify diameters e identify interior angles f identify exterior angles 2 Classify polygons a classify triangles by sides/angles b classify quadrilaterals (e.g., parallelogram, rectangle, rhombus, trapezoid) 3 Recognize similar and congruent figures 5 Visualize, draw, and construct geometric figures	3 Formulate and solve problems that involve collecting and analyzing data 4 Calculate and interpret the probability of an event	1 Create a word problem to illustrate a given equation, or write an equation to illustrate a given problem 4 Follow a series of instructions in sequential order a in a flow chart b in a diagram c in a narrative	1 Solve problems involving money in consumer situations a involving simple interest b involving total cost of installment purchases c involving total cost of purchases including sales tax d involving discounts e involving sale prices 3 Solve problems involving area and perimeter in consumer situations 4 Solve problems using proportion in consumer situations a involving pricing b involving recipe conversion c involving medication dosage d involving relative distances between locations

GRADE LEVEL 9	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
9	5 Use mathematical relationships to simplify expressions a mathematical expressions b algebraic expressions 7 Apply number theory concepts	2 Compute using scientific notation 7 Solve linear equations a one/two steps with integral coefficients and integral or rational solutions	2 Judge reasonableness of solutions or estimates of solutions to problems 4 Determine the relative magnitude of fractional numbers 5 Solve problems utilizing estimation a consumer situations b practical situations	5 Compute the area and perimeter of irregularly shaped figures 11 Solve problems involving measurement a volume of cylinders b volume of rectangular solids	1 Recognize properties and relationships of lines and angles 4 Determine if a given point is on the graph of a given equation 5 Visualize, draw, and construct geometric figures 6 Solve problems using measures of inclination: (slope)	2 Calculate and interpret the probability of an event 3 Formulate and solve problems that involve collecting and analyzing statistical data a draw inferences b evaluate conclusions c solve problems involving mean, median, mode, and range 4 Judge the reliability of inferences drawn from statistical data	1 Translate word phrases and sentences into algebraic expressions and equations 2 Evaluate the validity of conclusions drawn from given premises and definitions 3 Identify impediments to solving a given problem a information to solve a problem b information missing to solve a problem c information unnecessary to solve a problem d information that needs to be converted to another form	1 Solve problems involving volume and area in consumer situations 2 Solve problems using proportion in consumer situations a involving pricing b involving food, recipes, and nutrition c involving medication dosage d involving relative distances between locations 3 Investigate problems involving personal finance 4 Compute gross pay using hourly, monthly, commission, piecework, and/or overtime rates

GRADE LEVEL 10	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
10	5 Use mathematical relationships to simplify expressions a mathematical expressions b algebraic expressions	7 Solve linear equations a with decimal coefficients b with fractional coefficients c with integral coefficients 10 Solve formulas for a given variable	1 Estimate solutions for various computational problems a using scientific notation b using whole numbers c using fractions d using decimals 2 Judge reasonableness of solutions 5 Solve problems utilizing estimation a on consumer situations b on practical situations	5 Solve problems requiring the application of the Pythagorean theorem a given diagrams and measurements of right triangles b given a situation involving a right triangle 11 Solve problems involving measurement	1 Recognize properties and relationships of lines and angles a parallel and perpendicular lines b complementary and supplementary angles c alternate interior and corresponding angles d calculate the third angle of a triangle 3 Graph equations a plot the graph of a linear equation b identify the graph of a linear equation c identify the slope of a line given its graph and equation d use the graph of a line to identify its equation 5 Visualize, draw, and construct geometric figures 6 Solve problems using the concepts of symmetry, similarity, and congruence a determine lines of symmetry b use the concept of congruence	2 Calculate and interpret the probability of an event 3 Identify limitations of an inference drawn from statistical data a limitations to an inference b additional information needed c demonstrable bias	1 State logical conclusions from given conditions 2 Evaluate the acceptability of a conclusion drawn through logical inference	2 Solve banking problems related to maintaining a checking account 4 Use appropriate information and tables to compute net pay, considering Social Security deductions, state and federal taxes, etc.

INTEGRATING VOCATIONAL COMPETENCIES AND MATH SKILLS

WELDING

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FOREWORD

National interest and legislation support the need for identifying core competencies and key skills taught in industrial education classes. An understanding of the basic competencies involved will help identify academic subjects as they relate to specific occupations.

The following program area/math skills matrix can therefore be a valuable resource for program integration of academics, pre-testing and skills assessment, and special needs curriculum development. It identifies the math core competencies and key skills required for/taught in one of ten program areas at the Missouri secondary level. Matrices were developed for: Air Conditioning, Heating, and Refrigeration; Auto Collision Technology; Automotive Technology; Building Trades; Drafting; Electronics; Graphic Arts (Offset Lithography); Health Services Assistant; Machine Technology; and Welding.

The materials used to create the matrix include: the 1990 Core Competencies and Key Skills for Missouri Schools, grades two through ten; and Instructional Materials Laboratory vocational program competency profiles for the program areas involved.

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TO THE INSTRUCTOR: SUGGESTIONS FOR USE

The matrix that follows is divided into three columns. Reading in a row across all three of the columns will identify which math skills are involved in each vocational competency and tell whether the math skills are new to students or simply need reinforcement.

The first column identifies the vocational competencies involved in the program area. The numbers and competencies in this column refer to the Instructional Materials Laboratory competency profile for the program area.

The second column identifies which math skills are involved in the vocational competencies. The skills and numbers listed in this column refer to the 1990 Core Competencies and Key Skills for Missouri Schools, grades two through ten. (The list can also stand alone as a general list of math skills.) The column is blank for any vocational competency that the committee members decided did not require math skills.

Additional information about the math skills listed in the second column of the matrix may be found in the appendix following the matrix. The appendix is based on the math skills identified in the 1990 Core Competencies and Key Skills for Missouri Schools.

The last column tells whether the math skills will be new to students in the vocational classroom or whether they have been covered by math courses in the second through tenth grades. You may want to review and/or reinforce the math skills that students already have, and to make arrangements for them to learn the skills that are new to them.

As you use the matrix to help students learn or review math skills, keep in mind that different students learn in different ways. Efforts should be made to ensure that all students have an equal opportunity to understand and learn the material, regardless of race, color, national origin, gender, age, or disability.

Hold high expectations for all students, and provide the instruction necessary for students to meet those expectations. It is important that students achieve in math because research has shown a link between attitude toward mathematics and science, self-esteem levels, and career aspirations. According to a survey by the American Association of University Women: "Girls and boys who like mathematics and science have higher self-esteem, more ambitious career goals, and are more likely to hold onto their dreams."

As you help students achieve and develop this positive attitude toward mathematics, be aware that students of different genders give different reasons for their lack of interest in math. The AAUW survey states: "The gender differences in the intertwining of self-esteem and math/science interest is most evident in girls' and boys' reasons for their declining interest in math and science. While boys 'externalize' by seeing math and science as unimportant, girls 'internalize' by thinking themselves not smart enough."

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
A1. Identify and correct or report safety hazards		
A2. Identify and utilize proper storage for flammables		
A3. Identify and demonstrate correct use of fire extinguishers		
A4. Identify ventilation hazards and take corrective action		
A5. Observe and adhere to safety labels		
A6. Maintain, use and safely work with machines, tools and equipment	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Estimation - Determine a reasonable estimate (7C-1) Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1)	R R R R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
A7. Obtain and use reference books and charts	Understanding Numbers	
	• Communicate and interpret numbers (7A-1)	R
	• Compare positive rational numbers (7A-2)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Follow a series of instructions in sequential order (8G-4)	R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
A8. Apply math to solution of welding problems - whole numbers, fractions, decimals, geometry and trigonometry	Understanding Numbers	R
	• Use mathematical relationships to simplify expressions (9A-5)	
	Computation	
	• Add and subtract whole numbers with up to four addends (4B-4)	R
	• Multiply and divide whole numbers (3-digit by 2-digit) (5B-5)	R
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	• Solve linear equations (10B-7)	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	• Solve formulas for a given variable (10B-10)	R
	Estimation	
	• Use estimation strategies and mental computation to determine if an answer is reasonable (7C-2)	R
	Measurement	
	• Solve problems requiring the application of the Pythagorean theorem (10D-5)	R
	Problem Solving	
	• Identify unnecessary or missing numerical data in a word problem (7G-3)	R
	• Identify impediments to solving a given problem (9G-3)	R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
A9. Identify basic hand tools		
A10. Select, use and care for hand tools		
A11. Use power machinery, grinder, drill press and power saw safely/correctly	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Computation - Compute solutions of problems involving percents (7B-12) Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) Graphing and Statistics - Systematically collect, organize, and classify data (7F-1) - Construct, read, and interpret displays of data (7F-2) Problem Solving - Follow a series of instructions in sequential order (8G-4)	R R R R R R R
A12. Properly store electrodes and filler materials	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Problem Solving - Follow a series of instructions in sequential order (8G-4)	R R R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
A13. Read and implement welding procedures	Understanding Numbers	
	• Communicate and interpret numbers (7A-1)	R
	• Compare positive rational numbers (7A-2)	R
	Computation	
	• Recall fraction/decimal/percent equivalents (7B-1)	R
	• Compute the sum, difference, product, or quotient of fractions (7B-8)	R
	Estimation	
	• Judge reasonableness of solutions or estimates of solutions to problems (9C-2)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R
	• Solve problems involving measurement (10D-11)	R
	Geometry	
	• Visualize, draw, and construct geometric figures (9E-5)	R
	Consumer Problems	
	• Solve problems involving area and perimeter in consumer situations (8H-3)	R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
A14. Identify basic power sources	Understanding Numbers	
	• Communicate and interpret numbers (7A-1)	R
	• Compare positive rational numbers (7A-2)	R
	Computation	
	• Solve linear equations (number sentences) (7B-7)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R
	Problem Solving	
	• Follow a series of instructions in sequential order (8G-4)	R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
A15. Perform a weld test (destructive/nondestructive)	Understanding Numbers	
	• Communicate and interpret numbers (7A-1)	R
	• Compare positive rational numbers (7A-2)	R
	Computation	
	• Use operations in the correct order (7B-9)	R
	Estimation	
	• Determine a reasonable estimate (7C-1)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	Graphing and Statistics	
	• Systematically collect, organize, and classify data (7F-1)	R
	Problem Solving	
	• Identify unnecessary or missing numerical data in a word problem (7G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
B1. Read and interpret basic prints	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Computation - Use operations in the correct order (7B-9) Estimation - Determine the relative magnitude of fractional numbers (9C-4) Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Compute the area and perimeter of irregularly shaped figures (9D-5) - Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6) Geometry - Recognize properties and relationships of lines and of angles (parallel and perpendicular lines, complementary and supplementary angles, alternate interior and corresponding angles, calculate third angle of a triangle) (10E-1)	R R R R R R R R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
B1. Read and interpret basic prints (cont'd.)	Problem Solving	R
	- Identify impediments to solving a given problem (9G-3) - Follow a series of instructions in sequential order (8G-4)	R
	Consumer Situations	R
	- Solve problems involving area and perimeter in consumer situations (8H-3) - Solve problems using proportion in consumer situations (8H-4)	R
B2. Interpret welding symbols, abbreviations and joint designs	Understanding Numbers	R
	- Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2)	R
	Estimation	R
	Solve problems utilizing estimation (10C-5)	R
	Geometry	R
	- Recognize properties and relationships of lines and angles (identify bisectors, radii, diagonals, diameters, interior and exterior angles) (8E-1) - Solve problems using the concepts of symmetry, similarity, and congruence (10E-6)	R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
B3. Construct an exercise(s) using basic print and sketch	Understanding Numbers	
	• Communicate and interpret numbers (7A-1)	R
	• Compare positive rational numbers (7A-2)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
B4. Make sketches - pictorial and orthographic	• Estimate measurement (8D-2)	R
	• Solve problems involving measurement (volume) (9D-11)	R
	Problem Solving	
	• Follow a series of instructions in sequential order (8G-4)	R
B4. Make sketches - pictorial and orthographic	Understanding Numbers	
	• Communicate and interpret numbers (7A-1)	R
	• Compare positive rational numbers (7A-2)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
B4. Make sketches - pictorial and orthographic	• Estimate measurement (8D-2)	R
	Problem Solving	
	• Follow a series of instructions in sequential order (8G-4)	R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
B5. Interpret structural shapes, sizes and weights	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Estimation - Use estimation strategies and mental computation to determine if an answer is reasonable (7C-2) - Solve problems utilizing estimation (10C-5) Measurement - Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6) Consumer Problems - Solve problems involving volume and area in consumer situations (9H-1)	R R R R R
C1. Demonstrate safety procedures		
C2. Identify types of fuels and their application		
C3. Handle, make preliminary safety inspection and store cylinders properly		

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
C4. Identify, select and set up oxy-fuel welding and cutting equipment	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) Graphing and Statistics - Construct, read, and interpret displays of data (7F-2)	R R R R
C5. Light and adjust flame for welding and cutting		
C6. Pierce holes and cut slots		

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
C7. Make straight 90 degree and beveled cuts on mild steel plate and pipe	Understanding Numbers	
	• Communicate and interpret numbers (7A-1)	R
	• Compare positive rational numbers (7A-2)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (identify bisectors, radii, diagonals, diameters, interior and exterior angles) (8E-1)	R
	• Recognize properties and relationships of lines and of angles (parallel and perpendicular lines, complementary and supplementary angles, alternate interior and corresponding angles, calculate third angle of a triangle) (10E-1)	R
	• Solve problems using measures of inclination (9E-6)	R
	• Solve problems using the concepts of symmetry, similarity, and congruence (10E-6)	R
	Problem Solving	
	• Identify unnecessary or missing numerical data in a word problem (7G-3)	R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
C8. Make circle cuts - off hand and with guide	Understanding Numbers	
	• Communicate and interpret numbers (7A-1)	R
	• Compare positive rational numbers (7A-2)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (identify bisectors, radii, diagonals, diameters, interior and exterior angles) (8E-1)	R
	• Recognize properties and relationships of lines and of angles (parallel and perpendicular lines, complementary and supplementary angles, alternate interior and corresponding angles, calculate third angle of a triangle) (10E-1)	R
	• Solve problems using measures of inclination (9E-6)	R
	• Solve problems using the concepts of symmetry, similarity, and congruence (10E-6)	R
	Problem Solving	
	• Identify unnecessary or missing numerical data in a word problem (7G-3)	R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
C9. Layout, cut and fit pipe, plate and structural shapes	Understanding Numbers	
	• Communicate and interpret numbers (7A-1)	R
	• Compare positive rational numbers (7A-2)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (identify bisectors, radii, diagonals, diameters, interior and exterior angles) (8E-1)	R
	• Recognize properties and relationships of lines and of angles (parallel and perpendicular lines, complementary and supplementary angles, alternate interior and corresponding angles, calculate third angle of a triangle) (10E-1)	R
	• Solve problems using measures of inclination (9E-6)	R
	• Solve problems using the concepts of symmetry, similarity, and congruence (10E-6)	R
	Problem Solving	
	• Identify unnecessary or missing numerical data in a word problem (7G-3)	R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
C10. Run stringer bead without filler metal		
C11. Run stringer bead and joints with filler metal in flat position	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Problem Solving - Follow a series of instructions in sequential order (8G-4)	R R R
C12. Run stringer bead and joints with filler metal in horizontal position	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Problem Solving - Follow a series of instructions in sequential order (8G-4)	R R R
C13. Run stringer bead and joints with filler metal in vertical position	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Problem Solving - Follow a series of instructions in sequential order (8G-4)	R R R
C14. Run stringer bead and joints with filler metal in overhead position	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Problem Solving - Follow a series of instructions in sequential order (8G-4)	R R R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
C15. Braze weld carbon steel		
C16. Braze weld cast iron		
C17. Prepare weld for testing and pass visual test	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Estimate measurement (8D-2) - Solve problems involving measurement (7D-11) Problem Solving - Identify impediments to solving a given problem (9G-3) - Follow a series of instructions in sequential order (8G-4)	R R R R R R R
C18. Identify welding and cutting problems, their causes and take corrective action		
C19. Identify and select correct welding/brazing rod	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2)	R R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
D1. Make layout of material for plate, structural and pipe fabrication	Understanding Numbers	
	• Communicate and interpret numbers (7A-1)	R
	• Compare positive rational numbers (7A-2)	R
	Estimation	
	• Determine the relative magnitude of fractional numbers (9C-4)	R
	Measurement	
	• Solve problems involving measurement (7D-11)	R
	Geometry	
	• Recognize properties and relationships of lines and of angles (parallel and perpendicular lines, complementary and supplementary angles, alternate interior and corresponding angles, calculate third angle of a triangle) (10E-1)	R
	• Solve problems using the concepts of symmetry, similarity, and congruence (10E-6)	R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
D2. Prepare material for weld procedure	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Estimation - Determine the relative magnitude of fractional numbers (9C-4) Measurement - Solve problems involving measurement (7D-11) Geometry - Recognize properties and relationships of lines and of angles (10E-1) - Solve problems using the concepts of symmetry, similarity, and congruence (10E-6)	R R R R R R
E1. Demonstrate safety procedures		
E2. Describe theory of shielded metal arc welding		
E3. Identify and select power source and set current for weld procedure	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) Problem Solving - Follow a series of instructions in sequential order (8G-4)	R R R R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
E4. Identify and make proper electrode selection for base material and material thickness	Understanding Numbers • Communicate and interpret numbers (7A-1) • Compare positive rational numbers (7A-2) Problem Solving • Follow a series of instructions in sequential order (8G-4)	R R R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
E5. Identify joint design and prepare material for weld procedure	Understanding Numbers	
	• Communicate and interpret numbers (7A-1)	R
	• Compare positive rational numbers (7A-2)	R
	Computation	
	• Use operations in the correct order (7B-9)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	• Solve problems involving measurement (7D-11)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (identify bisectors, radii, diagonals, diameters, interior and exterior angles) (8E-1)	R
	• Recognize properties and relationships of lines and of angles (parallel and perpendicular lines, complementary and supplementary angles, alternate interior and corresponding angles, calculate third angle of a triangle) (10E-1)	R
	• Solve problems using the concepts of symmetry, similarity, and congruence (10E-6)	R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
E5. Identify joint design and prepare material for weld procedure (cont'd.)	Graphing and Statistics Systematically collect, organize, and classify data (7F-1)	R
	Problem Solving Identify unnecessary or missing numerical data in a word problem (7G-3)	R
E6. Identify welding problems, their causes and take corrective action		
E7. Build pad of beads in flat position with E-6010 or E-6011	Understanding Numbers Communicate and interpret numbers (7A-1)	R
	Compare positive rational numbers (7A-2)	R
	Computation Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Measurement Calculate the perimeter or the area of a triangle, rectangle, or square (8D-6)	R
	Problem Solving Identify unnecessary or missing numerical data in a word problem (7G-3)	R
	Consumer Problems - Solve problems involving area and perimeter in consumer situations (8H-3) - Solve problems using proportion in consumer situations (8H-4)	R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
E8. Build pad of beads in flat position with E-7024	Understanding Numbers	
	• Communicate and interpret numbers (7A-1)	R
	• Compare positive rational numbers (7A-2)	R
	Computation	
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Measurement	
	• Calculate the perimeter or the area of a triangle, rectangle, or square (8D-6)	R
	Problem Solving	
	• Identify unnecessary or missing numerical data in a word problem (7G-3)	R
	Consumer Problems	
	• Solve problems involving area and perimeter in consumer situations (8H-3)	R
	• Solve problems using proportion in consumer situations (8H-4)	R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
E9. Build pad of beads in flat position with E-7018	Understanding Numbers	
	• Communicate and interpret numbers (7A-1)	R
	• Compare positive rational numbers (7A-2)	R
	Computation	
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	• Calculate the perimeter or the area of a triangle, rectangle, or square (8D-6)	R
	Graphing and Statistics	
	• Systematically collect, organize, and classify data (7F-1)	R
	Problem Solving	
	• Identify unnecessary or missing numerical data in a word problem (7G-3)	R
	Consumer Problems	
	• Solve problems involving area and perimeter in consumer situations (8H-3)	R
	• Solve problems using proportion in consumer situations (8H-4)	R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
E10. Build pad of beads in horizontal position with E-6010 or E-6011	Understanding Numbers	
	• Communicate and interpret numbers (7A-1)	R
	• Compare positive rational numbers (7A-2)	R
	Computation	
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Measurement	
	• Calculate the perimeter or the area of a triangle, rectangle, or square (8D-6)	R
	Problem Solving	
	• Identify unnecessary or missing numerical data in a word problem (7G-3)	R
	Consumer Problems	
	• Solve problems involving area and perimeter in consumer situations (8H-3)	R
	• Solve problems using proportion in consumer situations (8H-4)	R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
E11. Build pad of beads in horizontal position with E-7018	Understanding Numbers	
	• Communicate and interpret numbers (7A-1)	R
	• Compare positive rational numbers (7A-2)	R
	Computation	
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Measurement	
	• Calculate the perimeter or the area of a triangle, rectangle, or square (8D-6)	R
	Problem Solving	
	• Identify unnecessary or missing numerical data in a word problem (7G-3)	R
	Consumer Problems	
	• Solve problems involving area and perimeter in consumer situations (8H-3)	R
	• Solve problems using proportion in consumer situations (8H-4)	R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
E12. Build pad of beads in vertical position with E-6010 or E-6011	Understanding Numbers	
	• Communicate and interpret numbers (7A-1)	R
	• Compare positive rational numbers (7A-2)	R
	Computation	
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Measurement	
	• Calculate the perimeter or the area of a triangle, rectangle, or square (8D-6)	R
	Problem Solving	
	• Identify unnecessary or missing numerical data in a word problem (7G-3)	R
	Consumer Problems	
	• Solve problems involving area and perimeter in consumer situations (8H-3)	R
	• Solve problems using proportion in consumer situations (8H-4)	R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
E13. Build pad of beads in vertical position with E-7018	Understanding Numbers	
	• Communicate and interpret numbers (7A-1)	R
	• Compare positive rational numbers (7A-2)	R
	Computation	
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Measurement	
	• Calculate the perimeter or the area of a triangle, rectangle, or square (8D-6)	R
	Problem Solving	
	• Identify unnecessary or missing numerical data in a word problem (7G-3)	R
	Consumer Problems	
	• Solve problems involving area and perimeter in consumer situations (8H-3)	R
	• Solve problems using proportion in consumer situations (8H-4)	R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
E14. Build pad of beads in overhead position with E-6010 or E-6011	Understanding Numbers	
	• Communicate and interpret numbers (7A-1)	R
	• Compare positive rational numbers (7A-2)	R
	Computation	
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Measurement	
	• Calculate the perimeter or the area of a triangle, rectangle, or square (8D-6)	R
	Problem Solving	
	• Identify unnecessary or missing numerical data in a word problem (7G-3)	R
	Consumer Problems	
	• Solve problems involving area and perimeter in consumer situations (8H-3)	R
	• Solve problems using proportion in consumer situations (8H-4)	R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
E15. Build pad of beads in overhead position with E-7018	Understanding Numbers	
	• Communicate and interpret numbers (7A-1)	R
	• Compare positive rational numbers (7A-2)	R
	Computation	
	• Add, subtract, multiply, and divide decimals and divide whole numbers (6B-6)	R
	Measurement	
	• Calculate the perimeter or the area of a triangle, rectangle, or square (8D-6)	R
	Problem Solving	
	• Identify unnecessary or missing numerical data in a word problem (7G-3)	R
	Consumer Problems	
	• Solve problems involving area and perimeter in consumer situations (8H-3)	R
	• Solve problems using proportion in consumer situations (8H-4)	R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
E16. Prepare weld for test	Understanding Numbers	
	• Communicate and interpret numbers (7A-1)	R
	• Compare positive rational numbers (7A-2)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Calculate the perimeter or the area of a triangle, rectangle, or square (8D-6)	R
	• Solve problems involving measurement (volume) (9D-11)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (identify bisectors, radii, diagonals, diameters, interior and exterior angles) (8E-1)	R
	• Recognize similar and congruent figures (8E-3)	R
	Problem Solving	
	• Identify unnecessary or missing numerical data in a word problem (7G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
F1. Make weld in 1F position with E-6010 or E-6011	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Graphing and Statistics - Construct, read, and interpret displays of data (7F-2)	R R R
F2. Make weld in 1F position with E-7024	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Graphing and Statistics - Construct, read, and interpret displays of data (7F-2)	R R R
F3. Make weld in 1F position with E-7018	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Graphing and Statistics - Construct, read, and interpret displays of data (7F-2)	R R R
F4. Make weld in 2F position with E-6010 or E-6011	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Graphing and Statistics - Construct, read, and interpret displays of data (7F-2)	R R R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
F5. Make weld in 2F position with E-7024	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Graphing and Statistics - Construct, read, and interpret displays of data (7F-2)	R R R
F6. Make weld in 2F position with E-7018	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Graphing and Statistics - Construct, read, and interpret displays of data (7F-2)	R R R
F7. Make weld in 3F position with E-6010 or E-6011	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Graphing and Statistics - Construct, read, and interpret displays of data (7F-2)	R R R
F8. Make weld in 3F position with E-7018	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Graphing and Statistics - Construct, read, and interpret displays of data (7F-2)	R R R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
F9. Make weld in 4F position with E-6010 or E-6011	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Graphing and Statistics - Construct, read, and interpret displays of data (7F-2)	R R R
F10. Make weld in 4F position with E-7018	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Graphing and Statistics - Construct, read, and interpret displays of data (7F-2)	R R R
F11. Make weld in 1G position with E-6010 or E-6011	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Graphing and Statistics - Construct, read, and interpret displays of data (7F-2)	R R R
F12. Make weld in 1G position with E-7024 (3 passes maximum)	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Graphing and Statistics - Construct, read, and interpret displays of data (7F-2)	R R R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
F13. Make weld in 1G position with E-7018	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Graphing and Statistics - Construct, read, and interpret displays of data (7F-2)	R R R
F14. Make weld in 2G position with E-6010 or E-6011	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Graphing and Statistics - Construct, read, and interpret displays of data (7F-2)	R R R
F15. Make weld in 2G position with E-7024 (3 passes maximum)	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Graphing and Statistics - Construct, read, and interpret displays of data (7F-2)	R R R
F16. Make weld in 2G position with E-7018	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Graphing and Statistics - Construct, read, and interpret displays of data (7F-2)	R R R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
F17. Make weld in 3G position with E-6010 or E-6011	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Graphing and Statistics - Construct, read, and interpret displays of data (7F-2)	R R R
F18. Make weld in 3G position with E-7018	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Graphing and Statistics - Construct, read, and interpret displays of data (7F-2)	R R R
F19. Make weld in 4G position with E-6010 or E-6011	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Graphing and Statistics - Construct, read, and interpret displays of data (7F-2)	R R R
F20. Make weld in 4G position with E-7018	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Graphing and Statistics - Construct, read, and interpret displays of data (7F-2)	R R R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
G1. Make weld in 1G position with E-6010 or E-6011	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Estimate measurement (8D-2) - Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6) Geometry - Recognize properties and relationships of lines and angles (7E-1) - Recognize similar and congruent figures (8E-3) Graphing and Statistics - Construct, read, and interpret displays of data (7F-2) Problem Solving - Identify unnecessary or missing numerical data in a word problem (7G-3) - Follow a series of instructions in sequential order (8G-4)	R R R R R R R R R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
G2. Make weld in 1G position with E-7024 (3 passes maximum)	Understanding Numbers	
	• Communicate and interpret numbers (7A-1)	R
	• Compare positive rational numbers (7A-2)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R
	• Recognize similar and congruent figures (8E-3)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Identify unnecessary or missing numerical data in a word problem (7G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
G3. Make weld in 1G position with E-7018	Understanding Numbers	
	• Communicate and interpret numbers (7A-1)	R
	• Compare positive rational numbers (7A-2)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R
	• Recognize similar and congruent figures (8E-3)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Identify unnecessary or missing numerical data in a word problem (7G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
G4. Make weld in 2G position with E-6010 or E-6011	Understanding Numbers	
	• Communicate and interpret numbers (7A-1)	R
	• Compare positive rational numbers (7A-2)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R
	• Recognize similar and congruent figures (8E-3)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Identify unnecessary or missing numerical data in a word problem (7G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
G5. Make weld in 2G position with E-7024 (3 passes maximum)	Understanding Numbers	
	• Communicate and interpret numbers (7A-1)	R
	• Compare positive rational numbers (7A-2)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R
	• Approximate and/or calculate areas and perimeters of irregularly-shaped regions (7D-6)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R
	• Recognize similar and congruent figures (8E-3)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Identify unnecessary or missing numerical data in a word problem (7G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
G6. Make weld in 2G position with E-7018	Understanding Numbers	
	• Communicate and interpret numbers (7A-1)	R
	• Compare positive rational numbers (7A-2)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R
	• Recognize similar and congruent figures (8E-3)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Identify unnecessary or missing numerical data in a word problem (7G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
G7. Make weld in 5G position with E-6010 or E-6011	Understanding Numbers	
	• Communicate and interpret numbers (7A-1)	R
	• Compare positive rational numbers (7A-2)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R
	• Recognize similar and congruent figures (8E-3)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Identify unnecessary or missing numerical data in a word problem (7G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
G8. Make weld in 5G position with E-7018	Understanding Numbers	
	• Communicate and interpret numbers (7A-1)	R
	• Compare positive rational numbers (7A-2)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R
	• Recognize similar and congruent figures (8E-3)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Identify unnecessary or missing numerical data in a word problem (7G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
G9. Make weld in 6G position with E-6010 or E-6011	Understanding Numbers	
	• Communicate and interpret numbers (7A-1)	R
	• Compare positive rational numbers (7A-2)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R
	• Recognize similar and congruent figures (8E-3)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Identify unnecessary or missing numerical data in a word problem (7G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
G10. Make weld in 6G position with E-7018	Understanding Numbers	
	• Communicate and interpret numbers (7A-1)	R
	• Compare positive rational numbers (7A-2)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R
	• Recognize similar and congruent figures (8E-3)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Identify unnecessary or missing numerical data in a word problem (7G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
H1. Make weld in 1F position with E-6010 or E-6011	Understanding Numbers	
	• Communicate and interpret numbers (7A-1)	R
	• Compare positive rational numbers (7A-2)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R
	• Recognize similar and congruent figures (8E-3)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Identify unnecessary or missing numerical data in a word problem (7G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
H2. Make weld in 1F position with E-7018	Understanding Numbers	
	• Communicate and interpret numbers (7A-1)	R
	• Compare positive rational numbers (7A-2)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R
	• Recognize similar and congruent figures (8E-3)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Identify unnecessary or missing numerical data in a word problem (7G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
H3. Make weld in 2F position with E-6010 or E-6011	Understanding Numbers	
	• Communicate and interpret numbers (7A-1)	R
	• Compare positive rational numbers (7A-2)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R
	• Recognize similar and congruent figures (8E-3)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Identify unnecessary or missing numerical data in a word problem (7G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
H4. Make weld in 2F position with E-7018	Understanding Numbers	
	• Communicate and interpret numbers (7A-1)	R
	• Compare positive rational numbers (7A-2)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R
	• Recognize similar and congruent figures (8E-3)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Identify unnecessary or missing numerical data in a word problem (7G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
H5. Make weld in 3F position with E-6010 or E-6011	Understanding Numbers	
	• Communicate and interpret numbers (7A-1)	R
	• Compare positive rational numbers (7A-2)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R
	• Recognize similar and congruent figures (8E-3)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Identify unnecessary or missing numerical data in a word problem (7G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
H6. Make weld in 3F position with E-7018	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Estimate measurement (8D-2) - Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6) Geometry - Recognize properties and relationships of lines and angles (7E-1) - Recognize similar and congruent figures (8E-3) Graphing and Statistics - Construct, read, and interpret displays of data (7F-2) Problem Solving - Identify unnecessary or missing numerical data in a word problem (7G-3) - Follow a series of instructions in sequential order (8G-4)	R R R R R R R R R R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
H7. Make weld in 4F position with E-6010 or E-6011	Understanding Numbers	
	• Communicate and interpret numbers (7A-1)	R
	• Compare positive rational numbers (7A-2)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R
	• Recognize similar and congruent figures (8E-3)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Identify unnecessary or missing numerical data in a word problem (7G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
H8. Make weld in 4F position with E-7018	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Estimate measurement (8D-2) - Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6) Geometry - Recognize properties and relationships of lines and angles (7E-1) - Recognize similar and congruent figures (8E-3) Graphing and Statistics - Construct, read, and interpret displays of data (7F-2) Problem Solving - Identify unnecessary or missing numerical data in a word problem (7G-3) - Follow a series of instructions in sequential order (8G-4)	R R R R R R R R R R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
H9. Make square butt weld in 1G position with E-6010 or E-6011	Understanding Numbers	
	• Communicate and interpret numbers (7A-1)	R
	• Compare positive rational numbers (7A-2)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R
	• Recognize similar and congruent figures (8E-3)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Identify unnecessary or missing numerical data in a word problem (7G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
H10. Make square butt weld in flat position with E-7018	Understanding Numbers	
	• Communicate and interpret numbers (7A-1)	R
	• Compare positive rational numbers (7A-2)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R
	• Recognize similar and congruent figures (8E-3)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Identify unnecessary or missing numerical data in a word problem (7G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
H11. Make square butt weld in horizontal position with E-6010 or E-6011	Understanding Numbers	
	• Communicate and interpret numbers (7A-1)	R
	• Compare positive rational numbers (7A-2)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R
	• Recognize similar and congruent figures (8E-3)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Identify unnecessary or missing numerical data in a word problem (7G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
H12. Make square butt weld in horizontal position with E-7018	Understanding Numbers	
	• Communicate and interpret numbers (7A-1)	R
	• Compare positive rational numbers (7A-2)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R
	• Recognize similar and congruent figures (8E-3)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Identify unnecessary or missing numerical data in a word problem (7G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
H13. Make square butt weld in vertical position with E-6010 or E-6011	Understanding Numbers	
	• Communicate and interpret numbers (7A-1)	R
	• Compare positive rational numbers (7A-2)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R
	• Recognize similar and congruent figures (8E-3)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Identify unnecessary or missing numerical data in a word problem (7G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
H14. Make square butt weld in vertical position with E-7018	Understanding Numbers	
	• Communicate and interpret numbers (7A-1)	R
	• Compare positive rational numbers (7A-2)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R
	• Recognize similar and congruent figures (8E-3)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Identify unnecessary or missing numerical data in a word problem (7G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
H15. Make square butt weld in overhead position with E-6010 or E-6011	Understanding Numbers	
	• Communicate and interpret numbers (7A-1)	R
	• Compare positive rational numbers (7A-2)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R
	• Recognize similar and congruent figures (8E-3)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Identify unnecessary or missing numerical data in a word problem (7G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
H16. Make square butt weld in overhead position with E-7018	Understanding Numbers	
	• Communicate and interpret numbers (7A-1)	R
	• Compare positive rational numbers (7A-2)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R
	• Recognize similar and congruent figures (8E-3)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Identify unnecessary or missing numerical data in a word problem (7G-3)	R
	• Follow a series of instructions in sequential order (8G-4)	R
I1. Demonstrate safety procedures		

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
12. Identify, select and safely handle shielding gases for various transfer modes	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Problem Solving - Follow a series of instructions in sequential order (8G-4)	R R R
13. Adjust current, voltage, wire feed rate and gas flow	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) Graphing and Statistics - Construct, read, and interpret displays of data (7F-2) Problem Solving - Follow a series of instructions in sequential order (8G-4)	R R R R R
14. Identify, select and set up equipment and explain functions	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Problem Solving - Follow a series of instructions in sequential order (8G-4)	R R R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
15. Identify and select solid wire electrode for carbon steel	Understanding Numbers Compare positive rational numbers (7A-2)	R
	Computation Recall fraction/decimal/percent equivalents (7B-1)	R
	Estimation Judge reasonableness of solutions (10C-2)	R
	Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Estimate measurement (8D-2)	R
	Geometry Recognize properties and relationships of lines and angles (9E-1)	R
	Graphing and Statistics - Construct, read, and interpret displays of data (7F-2) - Formulate and solve problems that involve collecting and analyzing data (8F-3)	R
		R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
16. Identify and select solid wire electrode for aluminum	Understanding Numbers Compare positive rational numbers (7A-2)	R
	Computation Recall fraction/decimal/percent equivalents (7B-1)	R
	Estimation Judge reasonableness of solutions (10C-2)	R
	Measurement Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Estimate measurement (8D-2)	R
	Geometry Recognize properties and relationships of lines and angles (9E-1)	R
	Graphing and Statistics - Construct, read, and interpret displays of data (7F-2) - Formulate and solve problems that involve collecting and analyzing data (8F-3)	R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
17. Identify and select solid wire electrode for stainless steel	Understanding Numbers Compare positive rational numbers (7A-2)	R
	Computation Recall fraction/decimal/percent equivalents (7B-1)	R
	Estimation Judge reasonableness of solutions (10C-2)	R
	Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Estimate measurement (8D-2)	R
	Geometry Recognize properties and relationships of lines and angles (9E-1)	R
	Graphing and Statistics - Construct, read, and interpret displays of data (7F-2) - Formulate and solve problems that involve collecting and analyzing data (8F-3)	R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
18. Identify types of cored wire electrodes for carbon steel and stainless steel	Understanding Numbers Compare positive rational numbers (7A-2)	R
	Computation Recall fraction/decimal/percent equivalents (7B-1)	R
	Estimation Judge reasonableness of solutions (10C-2)	R
	Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Estimate measurement (8D-2)	R
	Geometry Recognize properties and relationships of lines and angles (9E-1)	R
	Graphing and Statistics - Construct, read, and interpret displays of data (7F-2) - Formulate and solve problems that involve collecting and analyzing data (8F-3)	R
		R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
19. Select cored wire electrode for carbon steel	Understanding Numbers	
	• Compare positive rational numbers (7A-2)	R
	Computation	
	• Recall fraction/decimal/percent equivalents (7B-1)	R
	Estimation	
	• Judge reasonableness of solutions (10C-2)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Estimate measurement (8D-2)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (9E-1)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	• Formulate and solve problems that involve collecting and analyzing data (8F-3)	R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
I10. Build pad of beads in flat position with carbon steel-cored and solid wire (plate)	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Graphing and Statistics - Construct, read, and interpret displays of data (7F-2) Problem Solving - Follow a series of instructions in sequential order (8G-4)	R R R R
I11. Build pad of beads in horizontal position with carbon steel-cored and solid wire (plate)	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Graphing and Statistics - Construct, read, and interpret displays of data (7F-2) Problem Solving - Follow a series of instructions in sequential order (8G-4)	R R R R
I12. Build pad of beads in vertical position with carbon steel-cored and solid wire (plate)	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Graphing and Statistics - Construct, read, and interpret displays of data (7F-2) Problem Solving - Follow a series of instructions in sequential order (8G-4)	R R R R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
113. Build pad of beads in overhead position with carbon steel-solid wire (plate)	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Graphing and Statistics - Construct, read, and interpret displays of data (7F-2) Problem Solving - Follow a series of instructions in sequential order (8G-4)	R R R R
114. Make weld in 1F position with carbon steel-cored and solid wire	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Measurement - Solve problems involving measurement (7D-11) Geometry - Recognize properties and relationships of lines and angles (7E-1)	R R R R
115. Make weld in 1F position with aluminum	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Measurement - Solve problems involving measurement (7D-11) Geometry - Recognize properties and relationships of lines and angles (7E-1)	R R R R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
I16. Make weld in 1F position with stainless steel	Understanding Numbers	
	• Communicate and interpret numbers (7A-1)	R
	• Compare positive rational numbers (7A-2)	R
	Measurement	
I17. Make weld in 2F position with carbon steel-cored and solid wire	• Solve problems involving measurement (7D-11)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R
I18. Make weld in 2F position with aluminum	Understanding Numbers	
	• Communicate and interpret numbers (7A-1)	R
	• Compare positive rational numbers (7A-2)	R
	Measurement	
	• Solve problems involving measurement (7D-11)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
I19. Make weld in 2F position with stainless steel	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Measurement - Solve problems involving measurement (7D-11) Geometry - Recognize properties and relationships of lines and angles (7E-1)	R R R R
I20. Make weld in 3F position with carbon steel-cored and solid wire	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Measurement - Solve problems involving measurement (7D-11) Geometry - Recognize properties and relationships of lines and angles (7E-1)	R R R R
I21. Make weld in 4F position with carbon steel-cored and solid wire	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Measurement - Solve problems involving measurement (7D-11) Geometry - Recognize properties and relationships of lines and angles (7E-1)	R R R R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
I22. Make square butt weld in flat position with carbon steel-cored and solid wire	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Measurement - Solve problems involving measurement (7D-11) Geometry - Recognize properties and relationships of lines and angles (7E-1)	R R R R
I23. Make square butt weld in flat position with aluminum	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Measurement - Solve problems involving measurement (7D-11) Geometry - Recognize properties and relationships of lines and angles (7E-1)	R R R R
I24. Make square butt weld in flat position with stainless steel	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Measurement - Solve problems involving measurement (7D-11) Geometry - Recognize properties and relationships of lines and angles (7E-1)	R R R R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
I25. Make weld in 1G position with carbon steel-cored and solid wire	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Measurement - Solve problems involving measurement (7D-11) Geometry - Recognize properties and relationships of lines and angles (7E-1)	R R R R
I26. Make weld in 2G position with carbon steel-cored and solid wire	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Measurement - Solve problems involving measurement (7D-11) Geometry - Recognize properties and relationships of lines and angles (7E-1)	R R R R
I27. Make weld in 3G position with carbon steel-uphill	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Measurement - Solve problems involving measurement (7D-11) Geometry - Recognize properties and relationships of lines and angles (7E-1)	R R R R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
I28. Make weld in 3G position with carbon steel-downhill	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Measurement - Solve problems involving measurement (7D-11) Geometry - Recognize properties and relationships of lines and angles (7E-1)	R R R R
I29. Make weld in 5G position with carbon steel-downhill (pipe)	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Measurement - Solve problems involving measurement (7D-11) Geometry - Recognize properties and relationships of lines and angles (7E-1)	R R R R
I30. Make weld in 5G position with carbon steel-uphill (pipe)	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Measurement - Solve problems involving measurement (7D-11) Geometry - Recognize properties and relationships of lines and angles (7E-1)	R R R R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
I31. Make weld in 6G position with carbon steel (pipe)	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Measurement - Solve problems involving measurement (7D-11) Geometry - Recognize properties and relationships of lines and angles (7E-1)	R R R R
I32. Identify welding problems, their causes and take corrective action		
I33. Prepare weld for test	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Solve problems involving measurement (7D-11) Geometry - Recognize properties and relationships of lines and angles (7E-1) Graphing and Statistics - Systematically collect, organize, and classify data (7F-1) Problem Solving - Follow a series of instructions in sequential order (8G-4)	R R R R R R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
J1. Demonstrate safety procedures		
J2. Identify, select and set up equipment and explain function	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Solve problems involving measurement (7D-11) Geometry - Recognize properties and relationships of lines and angles (7E-1) Graphing and Statistics - Systematically collect, organize, and classify data (7F-1) Problem Solving - Follow a series of instructions in sequential order (8G-4)	R R R R R R R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
J3. Identify, select and safely handle shielding gases	Understanding Numbers	
	• Communicate and interpret numbers (7A-1)	R
	• Compare positive rational numbers (7A-2)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R
	Graphing and Statistics	
	• Systematically collect, organize, and classify data (7F-1)	R
	Problem Solving	
	• Follow a series of instructions in sequential order (8G-4)	R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
J4. Identify, select, shape and install tungsten electrode	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Solve problems involving measurement (7D-11) Geometry - Recognize properties and relationships of lines and angles (7E-1) Graphing and Statistics - Systematically collect, organize, and classify data (7F-1) Problem Solving - Follow a series of instructions in sequential order (8G-4)	R R R R R R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
J5. Adjust current, gas flow setting and post flow timer and strike arc	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Solve problems involving measurement (7D-11) Geometry - Recognize properties and relationships of lines and angles (7E-1) Graphing and Statistics - Systematically collect, organize, and classify data (7F-1) Problem Solving - Follow a series of instructions in sequential order (8G-4)	R R R R R R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
J6. Identify joint design and prepare material for weld procedure	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Measurement - Estimate measurement (8D-2) - Solve problems involving measurement (volume) (9D-11) Geometry - Recognize properties and relationships of lines and angles (7E-1) - Recognize properties and relationships of lines and angles (identify bisectors, radii, diagonals, diameters, interior and exterior angles) (8E-1) - Determine lines of symmetry in natural and geometric figures (7E-3) Problem Solving - Follow a series of instructions in sequential order (8G-4)	R R R R R R R R
J7. Select filler rod for base material	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2)	R R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
J8. Build pad of beads in flat position	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Measurement - Solve problems involving measurement (7D-11) Geometry - Recognize properties and relationships of lines and angles (7E-1) Problem Solving - Follow a series of instructions in sequential order (8G-4)	R R R R R
J9. Build pad of beads in horizontal position	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Measurement - Solve problems involving measurement (7D-11) Geometry - Recognize properties and relationships of lines and angles (7E-1) Problem Solving - Follow a series of instructions in sequential order (8G-4)	R R R R R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
J10. Build pad of beads in vertical position	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Measurement - Solve problems involving measurement (7D-11) Geometry - Recognize properties and relationships of lines and angles (7E-1) Problem Solving - Follow a series of instructions in sequential order (8G-4)	R R R R R
J11. Build pad of beads in overhead position	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Measurement - Solve problems involving measurement (7D-11) Geometry - Recognize properties and relationships of lines and angles (7E-1) Problem Solving - Follow a series of instructions in sequential order (8G-4)	R R R R R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
J12. Make weld in 1F position, stainless steel	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Measurement - Solve problems involving measurement (7D-11) Geometry - Recognize properties and relationships of lines and angles (7E-1) Problem Solving - Follow a series of instructions in sequential order (8G-4)	R R R R R
J13. Make weld in 1F position, aluminum	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Measurement - Solve problems involving measurement (7D-11) Geometry - Recognize properties and relationships of lines and angles (7E-1) Problem Solving - Follow a series of instructions in sequential order (8G-4)	R R R R R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
J14. Make weld in 1F position, carbon steel	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Measurement - Solve problems involving measurement (7D-11) Geometry - Recognize properties and relationships of lines and angles (7E-1) Problem Solving - Follow a series of instructions in sequential order (8G-4)	R R R R R
J15. Make weld in 2F position, stainless steel	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Measurement - Solve problems involving measurement (7D-11) Geometry - Recognize properties and relationships of lines and angles (7E-1) Problem Solving - Follow a series of instructions in sequential order (8G-4)	R R R R R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
J16. Make weld in 2F position, aluminum	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Measurement - Solve problems involving measurement (7D-11) Geometry - Recognize properties and relationships of lines and angles (7E-1) Problem Solving - Follow a series of instructions in sequential order (8G-4)	R R R R R
J17. Make weld in 2F position, carbon steel	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Measurement - Solve problems involving measurement (7D-11) Geometry - Recognize properties and relationships of lines and angles (7E-1) Problem Solving - Follow a series of instructions in sequential order (8G-4)	R R R R R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
J18. Make weld in 3F position, stainless steel	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Measurement - Solve problems involving measurement (7D-11) Geometry - Recognize properties and relationships of lines and angles (7E-1) Problem Solving - Follow a series of instructions in sequential order (8G-4)	R R R R R
J19. Make weld in 3F position, aluminum	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Measurement - Solve problems involving measurement (7D-11) Geometry - Recognize properties and relationships of lines and angles (7E-1) Problem Solving - Follow a series of instructions in sequential order (8G-4)	R R R R R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
J20. Make weld in 3F position, carbon steel	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Measurement - Solve problems involving measurement (7D-11) Geometry - Recognize properties and relationships of lines and angles (7E-1) Problem Solving - Follow a series of instructions in sequential order (8G-4)	R R R R R
J21. Make weld in 4F position, stainless steel	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Measurement - Solve problems involving measurement (7D-11) Geometry - Recognize properties and relationships of lines and angles (7E-1) Problem Solving - Follow a series of instructions in sequential order (8G-4)	R R R R R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
J22. Make weld in 4F position, aluminum	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Measurement - Solve problems involving measurement (7D-11) Geometry - Recognize properties and relationships of lines and angles (7E-1) Problem Solving - Follow a series of instructions in sequential order (8G-4)	R R R R R
J23. Make weld in 4F position, carbon steel	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Measurement - Solve problems involving measurement (7D-11) Geometry - Recognize properties and relationships of lines and angles (7E-1) Problem Solving - Follow a series of instructions in sequential order (8G-4)	R R R R R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
J24. Make weld in 1G position, stainless steel	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Measurement - Solve problems involving measurement (7D-11) Geometry - Recognize properties and relationships of lines and angles (7E-1) Problem Solving - Follow a series of instructions in sequential order (8G-4)	R R R R R
J25. Make weld in 1G position, aluminum	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Measurement - Solve problems involving measurement (7D-11) Geometry - Recognize properties and relationships of lines and angles (7E-1) Problem Solving - Follow a series of instructions in sequential order (8G-4)	R R R R R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
J26. Make weld in 1G position, carbon steel	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Measurement - Solve problems involving measurement (7D-11) Geometry - Recognize properties and relationships of lines and angles (7E-1) Problem Solving - Follow a series of instructions in sequential order (8G-4)	R R R R R
J27. Make weld in 2G position, stainless steel	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Measurement - Solve problems involving measurement (7D-11) Geometry - Recognize properties and relationships of lines and angles (7E-1) Problem Solving - Follow a series of instructions in sequential order (8G-4)	R R R R R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
J28. Make weld in 2G position, aluminum	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Measurement - Solve problems involving measurement (7D-11) Geometry - Recognize properties and relationships of lines and angles (7E-1) Problem Solving - Follow a series of instructions in sequential order (8G-4)	R R R R R
J29. Make weld in 2G position, carbon steel	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Measurement - Solve problems involving measurement (7D-11) Geometry - Recognize properties and relationships of lines and angles (7E-1) Problem Solving - Follow a series of instructions in sequential order (8G-4)	R R R R R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
J30. Make weld in 3G position, stainless steel	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Measurement - Solve problems involving measurement (7D-11) Geometry - Recognize properties and relationships of lines and angles (7E-1) Problem Solving - Follow a series of instructions in sequential order (8G-4)	R R R R R
J31. Make weld in 3G position, aluminum	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Measurement - Solve problems involving measurement (7D-11) Geometry - Recognize properties and relationships of lines and angles (7E-1) Problem Solving - Follow a series of instructions in sequential order (8G-4)	R R R R R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
J32. Make weld in 3G position, carbon steel	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Measurement - Solve problems involving measurement (7D-11) Geometry - Recognize properties and relationships of lines and angles (7E-1) Problem Solving - Follow a series of instructions in sequential order (8G-4)	R R R R R
J33. Identify welding problems, their causes and take corrective action		
J34. Prepare weld for test	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Measurement - Solve problems involving measurement (7D-11) Geometry - Recognize properties and relationships of lines and angles (7E-1) Problem Solving - Follow a series of instructions in sequential order (8G-4)	R R R R R
K1. Demonstrate safety procedures		

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
K2. Set up and operate plasma cutting equipment	Understanding Numbers	
	• Communicate and interpret numbers (7A-1)	R
	• Compare positive rational numbers (7A-2)	R
	Estimation	
	• Solve problems utilizing estimation (10C-5)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R
	Graphing and Statistics	
	• Systematically collect, organize, and classify data (7F-1)	R
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Follow a series of instructions in sequential order (8G-4)	R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
K3. Lay out and make straight line cuts on nonferrous metal	Understanding Numbers	
	• Communicate and interpret numbers (7A-1)	R
	• Compare positive rational numbers (7A-2)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	• Solve problems involving measurement (7D-11)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R
	• Recognize properties and relationships of lines and of angles (parallel and perpendicular lines, complementary and supplementary angles, alternate interior and corresponding angles, calculate third angle of a triangle) (10E-1)	R
	• Determine lines of symmetry in natural and geometric figures (7E-3)	R
	• Solve problems using the concepts of symmetry, similarity, and congruence (10E-6)	R
	Problem Solving	
	• Follow a series of instructions in sequential order (8G-4)	R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
K4. Lay out and make bevel cuts on nonferrous metal	Understanding Numbers	
	• Communicate and interpret numbers (7A-1)	R
	• Compare positive rational numbers (7A-2)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	• Solve problems involving measurement (7D-11)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R
	• Recognize properties and relationships of lines and of angles (parallel and perpendicular lines, complementary and supplementary angles, alternate interior and corresponding angles, calculate third angle of a triangle) (10E-1)	R
	• Determine lines of symmetry in natural and geometric figures (7E-3)	R
	• Solve problems using the concepts of symmetry, similarity, and congruence (10E-6)	R
	Problem Solving	
	• Follow a series of instructions in sequential order (8G-4)	R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
K5. Lay out and make circular cuts on nonferrous metal	Understanding Numbers	
	• Communicate and interpret numbers (7A-1)	R
	• Compare positive rational numbers (7A-2)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	• Solve problems involving measurement (7D-11)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R
	• Recognize properties and relationships of lines and of angles (parallel and perpendicular lines, complementary and supplementary angles, alternate interior and corresponding angles, calculate third angle of a triangle) (10E-1)	R
	• Determine lines of symmetry in natural and geometric figures (7E-3)	R
	• Solve problems using the concepts of symmetry, similarity, and congruence (10E-6)	R
	Problem Solving	
	• Follow a series of instructions in sequential order (8G-4)	R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
K6. Lay out and make pattern cuts on nonferrous metal	Understanding Numbers	
	• Communicate and interpret numbers (7A-1)	R
	• Compare positive rational numbers (7A-2)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	• Solve problems involving measurement (7D-11)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R
	• Recognize properties and relationships of lines and of angles (parallel and perpendicular lines, complementary and supplementary angles, alternate interior and corresponding angles, calculate third angle of a triangle) (10E-1)	R
	• Determine lines of symmetry in natural and geometric figures (7E-3)	R
	• Solve problems using the concepts of symmetry, similarity, and congruence (10E-6)	R
	Problem Solving	
	• Follow a series of instructions in sequential order (8G-4)	R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
K7. Lay out, cut and bevel pipe to a 30-37 1/2 degree angle on nonferrous metal	Understanding Numbers	
	• Communicate and interpret numbers (7A-1)	R
	• Compare positive rational numbers (7A-2)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	• Solve problems involving measurement (7D-11)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R
	• Recognize properties and relationships of lines and of angles (parallel and perpendicular lines, complementary and supplementary angles, alternate interior and corresponding angles, calculate third angle of a triangle) (7E-1)	R
	• Determine lines of symmetry in natural and geometric figures (7E-3)	R
	• Solve problems using the concepts of symmetry, similarity, and congruence (10E-6)	R
	Problem Solving	
	• Follow a series of instructions in sequential order (8G-4)	R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
K8. Lay out and cut square and round solid stock on nonferrous metal	Understanding Numbers	
	• Communicate and interpret numbers (7A-1)	R
	• Compare positive rational numbers (7A-2)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	• Solve problems involving measurement (7D-11)	R
	Geometry	
	• Recognize properties and relationships of lines and angles (7E-1)	R
	• Recognize properties and relationships of lines and of angles (parallel and perpendicular lines, complementary and supplementary angles, alternate interior and corresponding angles, calculate third angle of a triangle) (10E-1)	R
	• Determine lines of symmetry in natural and geometric figures (7E-3)	R
	• Solve problems using the concepts of symmetry, similarity, and congruence (10E-6)	R
	Problem Solving	
	• Follow a series of instructions in sequential order (8G-4)	R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
K9. Identify, select and safely handle cutting gases	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2)	R R
L1. Demonstrate safety procedures		
L2. Identify the classification and physical properties of ferrous and nonferrous metals	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Estimation - Determine a reasonable estimate (7C-1) Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6) - Solve problems involving measurement (7D-11) Graphing and Statistics - Construct, read, and interpret displays of data (7F-2) Problem Solving - Follow a series of instructions in sequential order (8G-4)	R R R R R R R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
L3. Identify and apply principles of preheating and postheating	Understanding Numbers	
	• Communicate and interpret numbers (7A-1)	R
	• Compare positive rational numbers (7A-2)	R
	Estimation	
	• Determine a reasonable estimate (7C-1)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	• Solve problems involving measurement (7D-11)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Follow a series of instructions in sequential order (8G-4)	R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
L4. Describe and apply principles of metallurgy in annealing, hardening and tempering	Understanding Numbers - Communicate and interpret numbers (7A-1) - Compare positive rational numbers (7A-2) Estimation - Determine a reasonable estimate (7C-1) Measurement - Choose the appropriate unit of precision for a given measurement situation (7D-1) - Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6) - Solve problems involving measurement (7D-11) Graphing and Statistics - Construct, read, and interpret displays of data (7F-2) Problem Solving - Follow a series of instructions in sequential order (8G-4)	R R R R R R R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
L5. Describe methods of testing metals	Understanding Numbers	
	• Communicate and interpret numbers (7A-1)	R
	• Compare positive rational numbers (7A-2)	R
	Estimation	
	• Determine a reasonable estimate (7C-1)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	• Solve problems involving measurement (7D-11)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Follow a series of instructions in sequential order (8G-4)	R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
L6. Identify types of ferrous metal by spark test	Understanding Numbers	
	• Communicate and interpret numbers (7A-1)	R
	• Compare positive rational numbers (7A-2)	R
	Estimation	
	• Determine a reasonable estimate (7C-1)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	• Solve problems involving measurement (7D-11)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Follow a series of instructions in sequential order (8G-4)	R

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
L7. Describe the relationship between the hardness test of weld, heat affect zone and base metal, and interpret the results	Understanding Numbers	
	• Communicate and interpret numbers (7A-1)	R
	• Compare positive rational numbers (7A-2)	R
	Estimation	
	• Determine a reasonable estimate (7C-1)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Approximate and/or calculate areas and perimeters of irregularly shaped regions (7D-6)	R
	• Solve problems involving measurement (7D-11)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Follow a series of instructions in sequential order (8G-4)	R
M1. Demonstrate safety procedures		

WELDING		
Vocational Competencies	Math Competencies	New (N) or Reinforced (R) Skills
M2. Set up and operate carbon-arc cutting equipment	Understanding Numbers	
	• Communicate and interpret numbers (7A-1)	R
	• Compare positive rational numbers (7A-2)	R
	Measurement	
	• Choose the appropriate unit of precision for a given measurement situation (7D-1)	R
	• Solve problems involving measurement (7D-11)	R
	Graphing and Statistics	
	• Construct, read, and interpret displays of data (7F-2)	R
	Problem Solving	
	• Follow a series of instructions in sequential order (8G-4)	R
M3. Remove weld material		

APPENDIX:

Additional Math Skills Information

Based on
1990 Core Competencies And Key Skills
For Missouri Schools

Mathematics
Grade 2-10

GRADE LEVEL 2	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
2	2 Compare whole numbers 3 Identify place value a the digit in the ones', tens', or hundreds' place b the place value of a given digit by name c the value of a digit in the ones', tens', or hundreds' place 4 Complete and create patterns a number b geometric c graphic 6 Identify fractional parts	2 Add whole numbers 3 Subtract whole numbers 7 Explore the use of open sentences to describe mathematical relationships a involving addition b involving subtraction c which represent given computational situations		3 Tell and record time	1 Describe, model, draw, and classify shapes a rectangles and squares b circles c triangles	2 Construct, read, and interpret displays of data a bar graphs b pictographs c other displays of data		2 Solve word problems involving addition 3 Solve word problems involving subtraction

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GRADE LEVEL 3	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
3	2 Compare numbers a compare two numbers using < or > b order a set of numbers by magnitude 3 Identify place value a the digit in the ones', tens', hundreds', or thousands' place b the place value of a given digit by name c the value of a digit in the ones', tens', hundreds', or thousands' place 6 Identify fractional parts	4 Add and subtract whole numbers with regrouping 5 Multiply whole numbers 7 Explore the use of open sentences to describe mathematical relationships a involving addition b involving subtraction c involving multiplication and division d identify open sentences that represent given computational situations		3 Tell and record time a relate various recording conventions to each other 5 Measure length, weight (mass), volume, and capacity using nonstandard and standard units a nearest inch b nearest centimeter c nearest pound or kilogram d nearest cup, pint, quart, gallon, and liter	2 Identify cones, cylinders, spheres, pyramids, and cubes	2 Construct, read, and interpret displays of data a read bar graphs and pictographs b contrast displays of data c interpret displays of data 3 Locate points on a grid		2 Solve word problems involving addition and subtraction of money 4 Solve word problems using addition, subtraction, and multiplication

GRADE LEVEL 4	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
4	3 Identify place value a the digit in the ones', tens', hundreds', thousands', or ten thousands' place b the place value of a given digit by name through ten thousands c the value of a specified digit(s) through the ten thousands' place 6 Graph points representing fractions on a number line a select the fraction represented by a given point on a number line b select the point on a number line representing a given fraction	4 Add and subtract whole numbers with up to four addends 5 Multiply whole numbers (3-digit by 1-digit) 7 Use open sentences to express mathematical relationships a identify the open sentence which represents a computational situation involving addition and/or subtraction, and multiplication and/or division b identify the computational situation which represents an open sentence involving addition and/or subtraction and multiplication and/or division	3 Recognize a situation in which an estimate or an exact answer is appropriate	2 Estimate measurements including area and perimeter of regular and irregular regions 5 Measure lengths a to the nearest half inch b to the nearest centimeter	2 Explore properties of right angles	2 Construct, read, and interpret displays of data a select bar graphs and pictographs b contrast displays of data		2 Solve problems involving money management a with computational algorithms b which may require nonstandard strategies 4 Solve standard multi-step word problems, using one or more than one operation 5 Solve nonstandard word problems

GRADE LEVEL 5	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
5	2 Compare unit fractions a compare two fractions using $<$ or $>$ b order a set of fractions by magnitude 3 Compare decimals a compare two decimals using $<$, $>$, or $=$ b order a set of decimals by magnitude 7 Apply number theory concepts a factors b multiples	5 Multiply and divide whole numbers (3-digit by 2-digit) 7 Solve number sentences a involving addition and subtraction with whole numbers and/or decimals b involving multiplication and division with whole numbers with 1-digit multipliers and divisors 8 Add and subtract like fractions	2 Use estimation strategies and mental computation to determine whether an answer is reasonable	2 Estimate measurements a linear measure b area, mass, and volume measures 6 Measure area and perimeter of regular and irregular regions using nonstandard and standard units 9 Convert units of measure within a system a metric system b English system	1 Identify properties of lines a intersecting, parallel, and perpendicular lines b vertical, horizontal, and diagonal (oblique) lines 4 Compare and classify geometric shapes and solids a similar figures b congruent figures c identify a figure with a specified number of lines of symmetry d regular polygons e right triangles	1 Systematically collect, organize, and describe data a best method for collecting data b accurate organization of given data c describe data using ratio and proportion 2 Construct, read, and interpret displays of data a identify graphs that accurately represent given data b interpret displays of data c construct displays of data		4 Solve standard multi-step word problems 5 Solve nonstandard word problems

GRADE LEVEL 6	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
6	2 Compare fractions and decimals a compare two fractions using $<$, $>$, or $=$ b compare two decimals using $<$, $>$, or $=$ c order a set of fractions or decimals by magnitude 4 Compare a numerical sequence 6 Graph points representing positive rational numbers on a number line a select the fraction or decimal represented by a given point b select the point representing a given fraction or decimal	6 Add, subtract, multiply, and divide whole numbers 7 Solve number sentences a involving whole numbers and decimals b involving whole numbers and like fractions 8 Multiply fractions a whole numbers and fractions b fractions with denominators less than 10 9 Use operations in the correct order		1 Choose an appropriate unit of measure and the corresponding tool for a given situation a within the metric system b within the English system 6 Calculate areas and perimeters a of squares and rectangles 9 Convert units of measure within a system a metric system b English system	4 Compare and classify geometric shapes and solids a similar figures b congruent figures c identify a figure with a specified number of lines of symmetry d regular polygons e right triangles	1 Systematically collect, organize, and describe data a best method for collecting data b accurate organization of given data 2 Construct, read, and interpret displays of data a identify graphs that accurately represent given data b interpret displays of data c construct displays of data		1 Solve word problems involving money 4 Solve standard multi-step word problems 5 Solve nonstandard word problems

GRADE LEVEL 7	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
7	1 Communicate and interpret numbers a interpret calculator displays b express numbers in scientific notation with positive exponents c express large numbers in conventional notation 2 Compare positive rational numbers a compare fraction to fraction b compare decimal to fraction 5 Use numerical relationships to describe and simplify numerical situations 7 Apply number theory concepts a classify numbers as prime or composite b factors c multiples d multiple classifications	1 Recall fraction/decimal/percent equivalents 7 Solve linear equations (number sentences) a one-step b two-step 8 Compute the sum, difference, product, or quotient of fractions 9 Use operations in correct order a with + and/or - and + b with + and/or - and x 12 Compute solutions of problems involving percents a calculate percent of a number b calculate percent one number is of another c calculate the whole when a percent is given	1 Determine a reasonable estimate 2 Use estimation strategies and mental computation to determine if an answer is reasonable 5 Solve problems utilizing estimation a utilizing percents b utilizing fractions c utilizing decimals	1 Choose the appropriate unit of precision for a given measurement situation a in metric measurements b in standard measurements 2 Estimate measurement 6 Approximate and/or calculate areas and perimeters of irregularly shaped regions 10 Investigate the relationships among circumference, area, and diameter of a circle 11 Solve problems involving measurement	1 Recognize properties and relationships of lines and angles 2 Classify polygons a classify regular polygons with five or more sides b classify irregular polygons with five or more sides c classify quadrilaterals 3 Determine lines of symmetry in natural and geometric figures a in a natural figure b in a plane geometric figure 5 Identify the plane geometric figures which form the surfaces of three dimensional projects	1 Systematically collect, organize, and classify data a collect and organize statistical data b describe the most appropriate measure c determine mean d determine median e determine mode f determine range 2 Construct, read, and interpret displays of data a construct graphic data displays b identify correctly constructed bar and line graphs, pie charts, pictographs, and scattergrams c interpret bar and line graphs, pie charts, pictographs, and scattergrams 3 Formulate and solve problems that involve collecting and analyzing data	1 Create a problem to illustrate a given numerical sentence 2 Write a number sentence to illustrate a problem 3 Identify unnecessary or missing numerical data in a word problem	2 Solve problems involving percent in consumer situations a sales tax b discount c commission 4 Solve problems using ratio and proportion in consumer situations a involving pricing b involving recipe conversion c involving medication dosage d involving relative distances between locations

GRADE LEVEL 8	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
8	1 Communicate and interpret numbers a convert rational numbers to scientific notation b convert scientific notation to rational numbers 2 Compare rational numbers a compare fraction to fraction b compare decimal to fraction 5 Use mathematical relationships to describe and simplify mathematical expressions 7 Apply number theory a determine powers b determine square roots c determine cube roots	6 Compute the sum, difference, product, or quotient of integers 7 Solve linear equations a one-step b two-step 9 Evaluate algebraic expressions, given values for the variables	2 Use estimation strategies and mental computation to determine if an answer is reasonable 5 Solve problems utilizing estimation a utilizing percents b utilizing fractions c utilizing decimals	2 Estimate measurement 6 Calculate the perimeter or the area of a triangle, rectangle, or square 10 Calculate the circumference or the area of a circle 11 Solve problems involving measurement	1 Recognize properties and relationships of lines and angles a identify bisectors b identify radii c identify diagonals d identify diameters e identify interior angles f identify exterior angles 2 Classify polygons a classify triangles by sides/angles b classify quadrilaterals (e.g., parallelogram, rectangle, rhombus, trapezoid) 3 Recognize similar and congruent figures 5 Visualize, draw, and construct geometric figures	3 Formulate and solve problems that involve collecting and analyzing data 4 Calculate and interpret the probability of an event	1 Create a word problem to illustrate a given equation, or write an equation to illustrate a given problem 4 Follow a series of instructions in sequential order a in a flow chart b in a diagram c in a narrative	1 Solve problems involving money in consumer situations a involving simple interest b involving total cost of installment purchases c involving total cost of purchases including sales tax d involving discounts e involving sale prices 3 Solve problems involving area and perimeter in consumer situations 4 Solve problems using proportion in consumer situations a involving pricing b involving recipe conversion c involving medication dosage d involving relative distances between locations

GRADE LEVEL 9	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
9	5 Use mathematical relationships to simplify expressions a mathematical expressions b algebraic expressions 7 Apply number theory concepts	2 Compute using scientific notation 7 Solve linear equations a one/two steps with integral coefficients and integral or rational solutions	2 Judge reasonableness of solutions or estimates of solutions to problems 4 Determine the relative magnitude of fractional numbers 5 Solve problems utilizing estimation a consumer situations b practical situations	5 Compute the area and perimeter of irregularly shaped figures 11 Solve problems involving measurement a volume of cylinders b volume of rectangular solids	1 Recognize properties and relationships of lines and angles 4 Determine if a given point is on the graph of a given equation 5 Visualize, draw, and construct geometric figures 6 Solve problems using measures of inclination: (slope)	2 Calculate and interpret the probability of an event 3 Formulate and solve problems that involve collecting and analyzing statistical data a draw inferences b evaluate conclusions c solve problems involving mean, median, mode, and range 4 Judge the reliability of inferences drawn from statistical data	1 Translate word phrases and sentences into algebraic expressions and equations 2 Evaluate the validity of conclusions drawn from given premises and definitions 3 Identify impediments to solving a given problem a information to solve a problem b information missing to solve a problem c information unnecessary to solve a problem d information that needs to be converted to another form	1 Solve problems involving volume and area in consumer situations 2 Solve problems using proportion in consumer situations a involving pricing b involving food, recipes, and nutrition c involving medication dosage d involving relative distances between locations 3 Investigate problems involving personal finance 4 Compute gross pay using hourly, monthly, commission, piecework, and/or overtime rates

GRADE LEVEL 10	UNDERSTANDING NUMBERS A	COMPUTATION B	ESTIMATION C	MEASUREMENT D	GEOMETRY E	GRAPHING AND STATISTICS F	PROBLEM SOLVING G	CONSUMER PROBLEMS H
10	5 Use mathematical relationships to simplify expressions a mathematical expressions b algebraic expressions	7 Solve linear equations a with decimal coefficients b with fractional coefficients c with integral coefficients 10 Solve formulas for a given variable	1 Estimate solutions for various computational problems a using scientific notation b using whole numbers c using fractions d using decimals 2 Judge reasonableness of solutions 5 Solve problems utilizing estimation a on consumer situations b on practical situations	5 Solve problems requiring the application of the Pythagorean theorem a given diagrams and measurements of right triangles b given a situation involving a right triangle 11 Solve problems involving measurement	1 Recognize properties and relationships of lines and angles a parallel and perpendicular lines b complementary and supplementary angles c alternate interior and corresponding angles d calculate the third angle of a triangle 3 Graph equations a plot the graph of a linear equation b identify the graph of a linear equation c identify the slope of a line given its graph and equation d use the graph of a line to identify its equation 5 Visualize, draw, and construct geometric figures 6 Solve problems using the concepts of symmetry, similarity, and congruence a determine lines of symmetry b use the concept of congruence	2 Calculate and interpret the probability of an event 3 Identify limitations of an inference drawn from statistical data a limitations to an inference b additional information needed c demonstrable bias	1 State logical conclusions from given conditions 2 Evaluate the acceptability of a conclusion drawn through logical inference	2 Solve banking problems related to maintaining a checking account 4 Use appropriate information and tables to compute net pay, considering Social Security deductions, state and federal taxes, etc.